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Needs, Uses, and Benefits of the National Topographic Map Series—A Symposium

Foreword

PRESIDENT WRIGHT: This afternoon we have a very interesting symposium on the needs, uses, and benefits of the national topographic map series.

We have a distinguished group of gentlemen here, who are indicated on our program. Dr. Thomas B. Nolan, the Assistant Director of the U. S. Geological Survey (USGS) will preside. I will introduce him and turn the meeting over to him now.

DR. NOLAN: Thank you, Mr. Wright. I am not going to say very much to start with, because the program committee has impressed on me that this is a long program this afternoon.

I would like to express my own appreciation, though, and I think I can probably speak for all of the Federal mapping agencies here in Washington, for what seems to me to be a very salutary change in scheduling a program such as this.

So often technical groups of this sort, when they have a meeting, tend to discuss details of their own activities. I think to those of us who are engaged in map making in government, it is a very beneficial experience to learn, as we hope to this afternoon, what other people think about and do with the maps that we spend so much time and effort on.

For that reason I am very glad indeed to be present today at this symposium on the needs for and the uses and the benefits of the national topographic map.

We have, first of all, a formal scheduled paper, and that will be followed by several somewhat less formal discussions. I think we can start right off with the initial paper, which is entitled, "The Value of Topographic Maps to the Tennessee Valley Program."

It will be presented by Reed A. Elliot, who is the Chief of Project Planning of the Tennessee Valley Authority (TVA).

I have been asked also on behalf of Mr. Elliot and the program committee to announce that associated with Mr. Elliot in the preparation of this paper was James S. Bowman, who is Chief Water Control Planning Engineer of the TVA.

Value of Topographic Maps to the Tennessee Valley Authority Program

By REED A. ELLIOT

CHIEF, PROJECT PLANNING, TENNESSEE VALLEY AUTHORITY

THE SCOPE of the TVA program, as related to the use of maps, can be illustrated by the size of the area involved, the variety of topographic conditions encountered, and the number and type of projects that have been built in the Tennessee River Valley. The Valley area of about 40,000 square miles includes topographic conditions ranging from gently rolling lowlands, to mountainous terrain as rugged as found anywhere in the eastern part of this country.

The main stem of the Tennessee River, extending a distance of about 650 miles from Knoxville, Tenn., to the Ohio River, falls approximately 500 feet. The

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tributary streams in the upper valley fall from 1,500 to more than 5,000 feet from their headwaters in the Cumberland and Appalachian Mountains to their confluence with the Tennessee River. During the period from 1933 to the present TVA forces have constructed 7 major water-control projects on the Tennessee River and 11 on tributary rivers. These projects together with those acquired by TVA and others owned by the Aluminum Company of America constitute an integrated system of 28 projects in the Tennessee Valley.

In the planning, design, construction, and operation of its projects, TVA has been confronted with the same problems, involving knowledge of the configuration of the ground and location and elevation of natural and cultural features, as any other organization engaged in undertakings of similar scope and magnitude.

It might be possible to accumulate the information required for the planning and design of such projects by transit and level surveys, resulting essentially in a cadastral map with elevations plotted at salient points. However, it is probably needless to point out to this group how time consuming and expensive this procedure would be as compared with the preparation of a topographic map by modern methods to proper scale and with suitable contour intervals. This is especially true in the rough or mountainous terrain such as covers a great part of the Tennessee Valley.

This paper will present and discuss briefly the uses that TVA has made of topographic maps of various kinds (particularly the 1:24,000 topographic sheets) in the planning, design, construction, and operation phases of its work. These primarily concern the engineering phases of the projects. Reference will be made to types of topographic maps, other than the quadrangle sheets, which were available during the early days of TVA to indicate the absolute necessity of topographic maps to work of this nature. To complete the picture, reference will also be made to the large-scale topographic maps of relatively limited areas that supplement the use of the quadrangle sheets.

MAPS AVAILABLE

The only maps generally covering the project areas at the time TVA was created were the old topographic sheets of the USGS, scale 1:125,000 with contour interval of 100 feet; and the maps of the Tennessee River Survey by the U. S. Engineers, scale 1:15,000 with contour interval of 10 feet. The scale and contour interval of the former were such as to afford only a general idea of the physiography in the areas of low relief. However, the latter had been prepared for the specific purpose of planning dams and reservoirs. They were based on mosaics made from aerial photographs, and upon these the contours had been drawn in the field by using them as planetable sheets. The horizontal control for these maps was not always precise, but they afforded abundant information that could have been obtained later only at the expense of a great deal of time and money. Without these, and until the new quadrangle sheets of the Valley mapping program became available, the program of the Authority would have been seriously handicapped. These army maps cover most of the main-river projects and many of the tributary projects.

Certain isolated quadrangles of the valley had been recently re-mapped by the USGS to scales of 1:62,500 and 1:24,000 but unfortunately these were too scattered to cover much of the project areas.

In 1936 the USGS and TVA jointly undertook to map the entire valley by

photogrammetric methods to a scale of 1:24,000 with contour intervals varying from 10 to 40 feet, depending on the steepness of the terrain. Although the mapping of the entire valley has not been completed, these maps have for some years covered the most important areas and have been in continual demand particularly in areas not reached by the Tennessee River Survey, or where the coverage of that survey was inadequate.

As projects have reached the planning and design stages, many small areas such as sites for structures, construction camps, villages and various relocations have been accurately mapped by planetable to large scale with contour intervals of from 2 to 5 feet.

PLANNING

It would be practically impossible to exaggerate the value of high grade topographic maps for the preliminary planning of water control projects such as those of the TVA system. Most of the considerations that contribute toward the final selection of the dam sites and the degree of development are, of course, directly or indirectly dependent on the available maps. Reference to the following specific uses in the planning stage will demonstrate the value of good maps with respect to savings in time and expense, and, perhaps more important, the reliability of conclusions.

Selection of dam sites.—With maps showing contours at intervals of 10 to 40 feet, the identification of potential dam sites is a simple procedure. This frequently makes it possible to select a number of alternative sites and to carry comparative studies to the point of definitely selecting one or two sites for detailed study without incurring the expense of detailed mapping of several sites.

In the early stages of project explorations, working drawings of dam site topography are obtained frequently by enlarging small areas of the quadrangle sheets to a horizontal scale of 1 inch equals 200 feet. General project lay-outs and rough estimates of quantities and costs can be made satisfactorily from this type of site topography.

As planning work progresses it is necessary to supplement the topographic detail of the quadrangle sheets with larger-scale work such as 5- or 10-foot contour intervals at a horizontal scale of 200 to 500 feet to the inch. Over limited areas, such as the location for powerhouse or navigation lock, it has been found desirable to have 2-foot contours plotted at a scale of 100 feet to the inch.

Geologic investigations.—Contour maps of large areas are extremely valuable in the geological investigation of dam and reservoir sites. Geologists use them as base maps for the delineation of geologic formations and structural features. In the hands of an experienced geologist, familiar with the area, the topographic details shown on such maps reveal much information relating to the character, distribution, and structure of the bedrock. From them may be determined conditions which have an important bearing on the watertightness of dam abutments and reservoir rims, conditions which require exploration and remedial treatment, and localities in rims where dikes are necessary. On the basis of good topographic maps, some tentatively selected dam sites can be eliminated from further consideration. In other cases, such maps reveal sufficient geologic information to indicate that a very limited subsurface investigation will be required to prove the degree of feasibility of a dam site.

Layout of project features.—Essentially, planning studies should establish the feasibility of a project by demonstrating the relation of estimated benefits to

costs. To accomplish this in a dependable manner the lay-out and preliminary design of the project features must be based on sound and reasonably complete topographic and geologic information. Although the final project design may differ in some respects from the early plans, such changes should not be such as to destroy the validity of the planning cost estimates. The topographic detail at the dam site will influence the location of the dam axis, and features such as powerhouse, spillway, intake structures, and navigation locks. When accurate topographic maps are available for initial planning work, there is less likelihood that the relation of such features will be changed in final design. In this respect good maps become insurance against unreliable cost estimates and also reduce the cost of final project design.

Determination of reservoir levels.—The establishment of proper reservoir operating levels requires dependable information concerning amount and nature of the land to be purchased, the extent of clearing, the necessary relocations or adjustments to existing highways, railroads, bridges, utilities, and cultural improvements. Ordinarily it is necessary to estimate a range of reservoir costs for varying degrees of development. This may take the form of a cost versus elevation curve, to be combined with other project costs for comparison with the benefits to be obtained. Such data must be obtained by study of the nature of the reservoir problem at several possible levels. Without reliable topographic maps, comparative reservoir studies involve a burdensome amount of field exploration and the results are seldom entirely satisfactory.

Highway and railroad relocations.—Relocation problems in the planning stage deserve a brief separate mention. Where the USGS-TVA topography maps are available, we have found it possible to make reliable preliminary estimates of the extent and cost of the highway and railroad relocations required with no field work other than a simple inspection trip. Good knowledge of probable highway relocations, at an early stage in our studies, has been a great help in estimating the total amount of land to be purchased and has thus contributed to the over-all reliability of reservoir cost estimates.

Determination of drainage areas.—The size of the drainage area involved is basic to any study of water development. In the early planning stages it is necessary to determine flood discharges for spillway design, and also as a basis for all studies of flood control provisions and the benefits to be obtained from flood protection. Satisfactory estimates of potential hydro power depend on reliable determination of the stream flow at a given location. These determinations are more readily and reliably made when good topographic maps are available, showing clearly the boundaries of a watershed.

Determination of reservoir volumes.—Determination of the volume of a potential reservoir is essential to early studies of stream flow regulation. Flood control investigations require dependable knowledge of the storage capacity of a reservoir at various levels. Estimates of dependable power supply include the regulating effect of available water in storage. The same is true for studies of irrigation possibilities and for some navigation systems which depend upon regulated stream flow to maintain navigable channel depths.

Successful day-to-day operation of the completed water control project or system requires accurate knowledge of the amount of storage releases or impoundments corresponding to changes in reservoir levels.

The USGS-TVA maps of a reservoir area provide a reliable and convenient

basis for the determination of reservoir volumes for planning studies and for future project operations.

Calculation of backwater curves.—In the calculation of backwater curves, caused by an obstruction in a stream, cross sections of the stream channel and the valley are essential for two purposes: (1) with the discharge and slope known for past floods, to compute the velocity and then determine the roughness factor in the various reaches of the stream, and (2) with this roughness factor and various flood discharges in the future, to compute the velocity and then the surface slope, reach by reach. The topographic map provides an ideal means for determining the points at which sections should be taken under varying conditions of flow, and for determining the area of the section. Although the sections might be run out in the field, selection of the proper locations without the aid of a topographic map would be next to impossible.

Calculation of channel volumes for flood routing.—Analysis of past floods as they passed down the natural channel, or routing of these floods, or possible future floods through the reservoir system, requires determination of the volume under the flood profiles or backwater curves for many different elevations. It would be practically impossible to determine these volumes in any other way than from suitable contour maps.

Adjustment to municipal water and sewerage systems.—Practically all of the TVA reservoirs have required some degree of adjustment of municipal sewerage or water systems. Accurate topographic maps are indispensable for the planning of sewer and water lines, pumping stations, and treatment plants. In cases where adequate topography was not available, planning of adjustments involved a considerable amount of field work. With maps showing 10- or 20-foot contour intervals, the general scheme of adjustment can usually be established in the office. With a few field checks at critical points, reliable lay-outs and preliminary estimates can be made without resorting to full-scale instrument surveys of the proposed pipe line and plant locations. Where conditions required most accurate knowledge of topography, maps were prepared from field surveys at a scale of 1 inch equals 50 feet with contours at 1-foot intervals.

DESIGN

Design, even more than planning, requires the study of many alternative locations and arrangements of structures (even after the general location has been selected) before the final plan is evolved. Topographic maps have been used extensively in connection with design of the following features:

Major dam and powerhouse structures.—Seven water-control projects with navigation locks and power generating facilities have been designed and built on the main river and eleven projects without locks on the tributaries. Large-scale topographic maps were prepared of the selected sites, and used as a basis for studies and estimates of cost of various arrangements. These maps were essential to the determination of the most economical location of the various features of the projects, and their accuracy was of particular importance in the choice of the best location for the long earth or rock embankments that constitute the non-overflow portion of the dam at many projects.

Layout of construction villages.—It has been necessary for TVA to build 10 major villages at construction projects, in addition to such facilities as dormitories, cafeterias, hospitals, and community centers. The first step after

the general site had been selected on the quadrangle sheets was to prepare a large-scale topo map with 2-foot contour interval. On this, paper locations were made of buildings required to serve the estimated population, together with the necessary grading of roads, water mains, sewers, and other services. Grades and grade lines were also established from the contours, and the whole plan transferred to the ground.

Selection of routes for highway and railroad relocations.—On account of inundation of existing highways and railroads by the reservoirs and to afford access to the projects, it has been necessary to locate and build 1,354 miles of new highway and 122 miles of new railroad. The use of topographic maps was not necessary for all of this mileage as, obviously, considerations other than topography fixed some of the locations, but on the longer locations, and particularly in rough terrain, too much cannot be said as to the tremendous savings effected by the use of USGS-TVA quadrangles, scale 1:24,000. Paper locations were made and ruling grades determined from these maps. It was usually possible to select the final route in the office and confine the preliminary field work to a reconnaissance of the selected line. Without these maps it would have been necessary to run alternate preliminary lines by transit and level, which many of you know is a heartbreaking job in the tangled slopes of the Southern Appalachians.

In addition to this saving in survey costs, we were confident that the best line had been found and we were able to convince the highway and railroad officials that a better line was not hidden away in the rock and brush through some unexplored gap.

The quadrangles are also of great use in determining the drainage areas tributary to bridge and culvert openings. The watershed lines are well-defined so that the area can be readily measured with a planimeter. The lengths and gradients of the streams can also be measured for the purpose of determining the time of concentration of storm run-off.

Navigation sailing lines.—As the main-river projects were completed, it became necessary to lay out and mark the navigation sailing lines which now reach from the mouth of the river at Paducah, Ky., to the source at the confluence above Knoxville, a distance of about 630 miles. Using the contours below the reservoir level, it was possible to outline the various minimum depths and to lay out the sailing line to give minimum length and curvature and at the same time to give the minimum navigable depth of 9 feet. The location of buoys could be spotted directly on the map. Using the contours above reservoir level, it was possible to locate dayboards and lights on the shore and to determine their visibility from any point on the sailing line.

Location of Transmission Lines.—The topography of the Tennessee Basin is such that the high-voltage transmission lines connecting the various generating plants with each other and with the load centers for all or a portion of their length traverse very rough country. It is standard practice to locate the routes of these lines on the topographic sheets and to select the final route after making preliminary designs and estimates.

After a reconnaissance examination of the route, the line is finally staked. Many of the difficulties discussed under highway and railroad relocation are avoided by this method of locating transmission lines.

CONSTRUCTION

The set-up of construction jobs such as those in the Tennessee Valley is greatly enhanced by having topographic maps available on which the relationship of the various elements of the job can be studied in a systematic manner.

Source of materials.—The topographic map on which the geology of the area has been outlined affords a convenient means of studying borrow pit and quarry sites for dam construction, the quantity and character of material available and the grades and routes over which it must be handled.

Construction roads.—The topographic map makes it possible to lay out the roads required to reach the different parts of the job and go ahead with further planning before detailed information becomes available.

Construction plant.—With the source of materials and location of roads determined, the lay-out of construction plant for the job can be started.

OPERATION

After a development has been completed and placed in operation, topographic maps continue to be useful in a number of fields.

Flood routing.—In routing floods through reservoirs and the remaining open reaches of the river system, it is essential to have data on cross-sectional areas in order that the volume of water stored or released by changes in stage or slope can be determined. This can best be done from topographic maps.

Benefits from flood control.—In determining benefits from flood reductions, the area actually flooded at the reduced stage and the area that would have been flooded under natural conditions can be outlined on a topographic map, and the damage that would have occurred in the enclosed area can be estimated from a field inspection.

Damage claims.—A topographic map affords a basis for studying damage claims that arise from various causes around an impounded reservoir.

Navigation charts.—The same topographic map on which the sailing line was laid out affords a base for the preparation of navigation charts showing the sailing line and locations of buoys, lights, markers, depths in various areas of the reservoirs, and prominent natural features along the shores.

CONCLUSION

The foregoing discussion of some of the uses by TVA of topographic maps has been devoted largely to the engineering phases in the development of the various dam and reservoir projects. It is not of course a complete statement of engineering uses of maps in connection with such projects, and it necessarily neglects discussion of important related uses of topographic maps such as in malaria control problems, forest resource investigations, watershed protection planning, and general management of reservoir areas.

Reliable topographic and geologic information is basic and indispensable to the proper development of water resources and it is hoped that this paper will express our conviction that the value of having accurate, broad-coverage topographic maps available for all stages of engineering investigations cannot be over-emphasized.

DR. NOLAN: We are very grateful indeed for this—in spite of your modest ending—very comprehensive and thoughtful paper on the use of topographic maps. It confirms

what I think all of us have believed, that the organization that you represent is a very fine engineering group indeed, and one which appreciates so highly the topographic maps that we are interested in.

I think it would be well if we continued with the scheduled group of discussion leaders at this time and postpone the general discussion until we have completed all of the planned groups of papers.

I would also like to take the liberty of changing the schedule of papers slightly. Two of our speakers have acquired other pressing engagements, including one on the Hill, and I think it is perhaps especially desirable to follow Mr. Elliot's paper by a discussion by Mr. Dixon.

Mr. Dixon is also a chief of project planning, this time for the Bureau of Reclamation, rather than for the TVA. Both organizations also have something in common in that they are both concerned with multiple purpose dams and related activities, and Mr. Elliot's paper has shown us, I think, multiple purpose maps.

Value of Topographic Maps to the Bureau of Reclamation

By JOHN W. DIXON

DIRECTOR, BRANCH OF PROJECT PLANNING, BUREAU OF RECLAMATION

I WANT to take just a few moments to talk rather informally about the use of various types of maps and to comment on Mr. Elliot's paper.

Principally I would like to make my remarks in four categories. The first would be very brief comments on Mr. Elliot's excellent paper; second, some general comments on the mapping series; third, I have had made in the Department of the Interior what you might call a thumbnail survey of the utility of the various types of maps in the mapping series (the Department of the Interior includes a good many agencies of the Federal Government that deal with the use of maps); and fourth, a few brief views with regard to the use of topographic maps by our own Bureau.

With regard to Mr. Elliot's paper, we were fortunate enough to have received from him, through the officers of the Association, a preliminary draft of the paper. This gave us an opportunity to learn a good many things about the use of maps and to get a few more ideas.

The work of the Bureau of Reclamation is in the Western portion of the United States—the 17 Western States, particularly, which are actually more than half of the continental area of the country. Mr. Elliot did not stress the use of topographic maps for irrigation, or very much for the related land-use purposes. In the West and in the East alike these related land-use purposes are very important wherever land-use development activities are directly related to the construction proposed or under way.

In an irrigation project, as you may all be aware, the dam and powerhouse and other features of the immediate construction job are one part of the problem. Getting the water out onto the land, conveying it in some cases for hundreds of miles through systems of canals, tunnels, and powerdrops—and some of those canals are big enough to run ships through—is another engineering job which requires extensive and detailed use of topographic maps.

The discussion of the topographic maps in Mr. Elliot's paper was particularly meticulous and very accurate as it pertained to the use of them for specific purposes. I think he referred down even to the detail of using aerial mosaics and aerial photographs as planetable sheets. We do the same thing and I am sure many of you have also done it. He has talked about the use of mosaics for construction purposes, preliminary estimates, and for final design purposes.

There appear to be, however, some aspects in the broader sense of the use of the words "topographic map" that we might deal with, a fundamental thought that would be worthwhile. The Bureau of Reclamation, for example, would not choose to attempt to evaluate, or could not evaluate, the benefits from topographic maps. Without them, we wouldn't be in business.

Many Federal, state, or private agencies utilize topographic maps in the same way as mentioned by Mr. Elliot of TVA. In order to get my own thinking organized, I have listed the uses into several service categories.

USES OF MAPS

Topographic maps are used in land classification. By that I mean not only land quality but also the topography and the drainage features that accompany it. These are required to ascertain whether or not an irrigation project is practical in a given area.

Farm plats are required for purposes that go all the way from being attached to legal documents for filing, or condemnation proceedings, or land acquisition, to farm lay-outs for development purposes.

Irrigation and distribution system; trail planning such as by the Forest Service or the Park Service; trail maps and fire-fighting; base maps for many special purposes; town sites and other facilities; landscaping maps; reforestation; erosion studies; and erosion control planning, are only a few of the service categories for which topographic maps are essential.

The USGS quadrangle sheets are of value for many preliminary purposes, and for a good many final purposes; but frequently they must be supplemented by maps of different scales, usually on a scale of 1 inch equals 1,000 feet, 400 feet, 200 feet, or even less. The lack of coverage is the greatest inadequacy, however, in the present series. In the future, the value of these maps will be, in our opinion, many times what it is today, so that the series should be completed expeditiously.

Aside from the quadrangle topographic maps there are others in the series. There are the river plan and profile sheets, and the more detailed reservoir surveys that are made by the USGS. They are extremely useful for general purposes. Some of the early surveys were of low accuracy. Nevertheless, in a great many areas of the country—and particularly in the West, which is not populated to the degree that is the East—those early profile series are still the best information that is available to us on the fall of the rivers, in many of the side streams. The accuracy of the newer surveys is fully consistent with the scale and normal order of accuracy for this type of map.

The river series has formed the basis for many planning reports, particularly what you might call the basin reports which have to do with laying out a comprehensive set of related plans, the details of which had not been developed in a refined degree, but which have to be fitted together in any event. In some instances the reservoir surveys have been found adequate for final reservoir planning, without supplemental surveys, except for dams and other structures.

USERS OF MAPS

Now let us concern ourselves with the different types of maps used by different types of agencies in our Department. This may be of significance to those of you who deal with those agencies, or who deal in the equipment which is used by those agencies. These agencies to which I refer are all in our own Department of the Interior. In each case, I will name the three or four types of maps that they use most frequently and the degree to which the maps may be most useful to those particular agencies, considering the functions that the agencies perform.

The Fish and Wildlife Service uses quadrangle sheets; their value is as a trail map or for planning work in general. They have insufficient coverage, but otherwise are excellent. The river and profile maps generally are not used, but may provide some information. Reservoir site surveys are generally of little use. The geologic folios are generally of little direct use.

The Bureau of Mines utilizes quadrangle sheets for geological mapping and interpretation, location and planning of jobs. They are very useful. The river plan and profiles are of little use to the Bureau of Mines, in general. The reservoir site surveys are of little use, except for mineral rights where reservoirs are to be developed. As a parenthetical remark, I needn't tell you that that sometimes happens. We have a very nice dam site out in Montana called the Tiber dam site, and we were about ready to start construction when they discovered oil in the reservoir. We aren't going further right now with it. To the Bureau of Mines, the geologic folios are very useful.

The Bureau of Land Management, which handles the public domain, finds the quadrangle sheets of great value. The river plan and profile sheets, however, are of minor value except for some potential use on erosion control. What you may not realize is that on the public domain which is under the supervision of our Department, the work ordinarily thought of as soil conservation work is done by the Interior Department, and not by the Soil Conservation Service. The SCS does the work in the national forests and on private lands, but the Bureau of Land Management does that same type of work on the public domain, which is a very large portion of the West. The reservoir surveys are of very little direct value to the Bureau of Land Management, nor are the geologic folios especially useful.

The Bureau of Indian Affairs is an agency with which some of you are familiar, but many aren't. The Indians, being wards of the United States, are taken care of to the best of the ability of the United States, with the aid of several self-supporting programs. They have, for example, their own irrigation works. That job for the Indians, however, is done by the Bureau of Indian Affairs rather than by the Bureau of Reclamation, because the irrigation program is tied in with and directly related to the educational and social improvement programs for the Indians. However, with regard to the utility of the mapping series, you will find that their needs are very similar to ours. Quadrangle sheets are quite useful, where available. In the West, particularly in the Indian areas, they aren't as available as in the East. River survey plan and profiles are used in the planning of irrigation, flood control, or erosion control works. Reservoir site surveys are useful in planning irrigation and flood control works.

The National Park Service also uses, especially, three types of maps. The quadrangle map sheets are very valuable for general location and identification, useful for general planning of facilities, very helpful to hikers and tourists, and an excellent base for the location of fires and for fire-fighting uses. The river plan

maps, however, are of little use, though they are of some use in the determination of grades of the trails along the streams and similar uses. Reservoir site surveys are of little direct value.

That is a quick view of the cross section of some of the uses of various types of maps by the various agencies in our Department. If you shuffle those together, you would find that every one of the types of maps in the series is very useful to at least one or more of the agencies, and the quadrangle sheets are useful to all of the agencies.

USE OF MAPS BY RECLAMATION BUREAU

Now, with regard to our own experience in the Bureau of Reclamation in the use of the various map series. The quadrangle maps we use as extensively as they are available. They are usually too small for detailed studies or construction use, and are of insufficient coverage, but they are extremely valuable, especially for preliminary work. The river plans and profiles are used for project reconnaissance wherever they are available. They are oftentimes used in the process of selecting between alternative plans.

The reservoir surveys are extremely useful to the Bureau of Reclamation, and I could go on and discuss that at some length. But frequently they do not extend high enough, and as often as not we have to extend them on up higher in order to make them really useful to us.

The geologic folios are excellent for general planning and hydrologic studies, and occasionally for construction material sources. They would be of more direct use, if they had greater detail of coverage, and were more readily available. Many of them are now out of print. It is indeed unfortunate to have a good document available, filed, perhaps, in the Library of Congress, and one good engineer in the middle of Nevada—wishing he had it.

The state topographic maps, which are published by the states with or without the cooperation of the USGS, are also quite useful. Too few states, however, are covered by them.

I hadn't mentioned before other maps that might be considered part of the series, such as the valuable aeronautical charts and other maps by the Coast and Geodetic Survey. They, too, are very useful, and within the limits of accuracy inherent in their scales and purposes. They frequently provide the best overall picture of the topographic situation in the mountainous West.

In closing my remarks, I would like to express appreciation to Mr. Elliot for his excellent and comprehensive paper, and to this Association for letting me give what, I am afraid, amounts to pretty much of a "checkerboard discussion." I trust that I have succeeded in pointing out that, while a good start has been made, as yet the Nation is inadequately supplied with topographic maps, river profiles, folios of geologic information, or many other types of basic data that fall within the field of interest of your Association. I hope that the Association can lend its full strength to improving that situation.

DR. NOLAN: Thank you, Mr. Dixon, we hope that you will stay as long as possible to listen to the rest of the discussion, but I know that you have another and perhaps very pressing engagement.

I think the Program Committee made a very good choice in their selection of Mr. Dixon as one who could express the interests of the Federal Agencies in the greater need and use for topographic maps.

As I understand their objective, they were also, and perhaps even more anxious to have a sort of grass-roots expression of this need. I believe the remaining speakers who are on the panel to discuss the general topic that we have today will represent either private industry or states. The group is almost equally divided between those two broad categories.

The Program Committee has provided me with some notes in which they said that they wanted to get a recognized authority in the field of state and regional planning to discuss the matters in which the national topographic maps are of use in all types of planning work. They made some inquiry of the President of the Association of State Planning Agencies and were told that within 40 miles of Washington we had an eminent authority who could talk clearly and convincingly on this subject. With that introduction, I will ask Mr. Pasarew to talk to you.

Importance of Topographic Maps to the Maryland Planning Commission

By I. A. PASAREW

DIRECTOR, MARYLAND PLANNING COMMISSION

BY VIRTUE of having been the Executive Director of the now extinct Maryland Commission on Postwar Reconstruction and Development and currently the Director of the Maryland State Planning Commission, I have been placed in a very favorable position to evaluate the benefits of readily available current topographic maps. Because of its geographical location and its many natural resources, Maryland underwent rapid development during World War II and the postwar era. Only 36 miles from center to center lie two of the Nation's major cities, Baltimore and Washington. Forming with these two cities a roughly equilateral triangle is Annapolis—significant beyond its size as the Capital of Maryland and as the seat of the U. S. Naval Academy.

IMPORTANCE OF MAPPING TO STATE PLANNING COMMISSION

Many problems, aftermaths of the war, were thrust upon the Maryland State Planning Commission as well as the local planning agencies. These were due to the unpredictable population growth and trends brought about by the overnight expansion of industries, facilities at the Naval Academy, and the expansion and creation of new Federal establishments. More than a million and a quarter persons now live within the Baltimore Metropolitan Area.

The Commission is called upon frequently by local levels of government and other State agencies concerning problems of housing, zoning, transportation, public utilities, aviation, recreation, capital improvements, economic surveys, and regional planning, Very often it is necessary that a hurried or preliminary appraisal be made which involves the use of an adequate topographical map. The USGS quadrangle sheets as presently prepared serve this purpose excellently.

The culture as well as other features indicated on these maps, assuming that they be up to date, are invaluable in carrying out studies of land uses for purposes for zoning and planning various public facilities. With the view of illustrating the actual application of the use of these maps, I would like to cite a few examples.

BAYSIDE PARK STUDY

The Commission recently made an extensive study of the present assets and future needs for non-urban public recreational areas, which indicated that one of the most serious deficiencies in recreational facilities in the State was the lack of State-owned beaches in the Chesapeake Bay Area. Recognizing this deficiency, the Legislature authorized the acquisition of a site adjacent to the Chesapeake Bay and its tributaries, to be used as a recreation and demonstration area for the social and economic betterment of the people of the State, and appropriated $250,000 for this purpose.

The Board of Natural Resources, which was authorized to conduct the investigations for the selection of a site, requested the Commission to assist in making this objective survey. Consequently, an option was taken on a site consisting of 675 acres at Sandy Point, in Anne Arundel County, for a State bayside park.

Inasmuch as the area was not as large as originally contemplated and in view of the necessity of making a determination before the expiration of the option, the Commission was called upon to make hurried studies and prepare estimates of cost for the proposed development of the area. Without the benefit of a detailed plot plan or survey of the parcel, our site planner utilized the information concerning the features of water, relief, and culture as given on the USGS quadrangle sheets and prepared three studies. This site plan (exhibit Scheme 3) has been adopted as the accepted plan for development. The property has since been purchased, a topographical survey and plot plan have been made, and the necessary preliminary construction is under way. It will be possible to open the park for public use this summer. Upon comparing this site plan with the detailed plot plan, with its contours shown at smaller intervals than those in the USGS sheets, it appears that no change in location of proposed facilities will be necessary.

LONG-TERM CAPITAL IMPROVEMENT PROGRAM

As another example, it is the duty of the Planning Commission to prepare and keep up to date a long-term development program of major State capital improvement projects, and submit to the Governor and General Assembly a periodic report showing the Commission's recommendations for public works construction at the various State institutions. In developing individual institutional programs and being without plot plans, it has been necessary to utilize the information shown on the USGS sheets in order to select tentatively the location of a water tank or sewage disposal plant for the purpose of preparing preliminary estimates of cost.

I might divert from what I have here to point out that ever so frequently time is a very important consideration in some of this planning effort, to the extent that if a program or planning can be fully developed and costs prepared on some reasonable basis, it means the difference between an appropriation either this year or 2 years from now, and for the institutions that are badly in need of such improvements, that is quite some delay. And as I have pointed out, with the use of these topographic maps, we can frequently save considerable time with great advantage.

STATE-WIDE AIRPORT STUDY

Presently, the Commission, in conjunction with the Maryland State Aviation Commission, is making an airport study of Maryland. In order to show significant factors influencing airport requirements for appropriate study, it was

decided that a general base land use map of the State be prepared, over which would be imposed a series of transparent overlays. Each overlay would indicate one factor of the many factors which would affect airport requirements. I have here this proposed base map (exhibit) from which one may observe that ranges of topography at 1,000-foot intervals are illustrated by a corresponding range in color. The actual elevations, topography, and other cultural features were either taken from, or checked for accuracy with, the USGS quadrangle sheets.

MARYLAND COORDINATE SYSTEM

The Commission recently published a handbook entitled "Manual of Coordinates for Places in Maryland." The grid coordinate system of the Coast and Geodetic Survey was adopted for the State of Maryland by authority of the Maryland General Assembly of 1939. This system, known as the "Maryland Coordinate System," has been utilized in the preparation of the Manual.

Along the outer edges of quadrangle sheets of the USGS, which have been recently published for Maryland, marginal ticks are now included. With these tick marks, the Maryland State grid can be inscribed; used in conjunction with the Manual, a simple method is provided for locating some 12,000 places within the State. This system has proved itself to be extremely useful; it has been adopted for general use by the State and local police, fire watchers, and local fire companies for the dispatching of emergency services.

MAPPING PROGRESS IN MARYLAND

The Commission is deeply interested in the matter of mapping to the extent that it jointly sponsored the Maryland Mapping Agency back in 1936. The purpose of this organization was to collect and correlate at one source all the maps of Maryland and its subdivisions made by Federal, State, regional, municipal, and private agencies, so that there would be one central point where all information concerning maps of Maryland would be available, and thereby eliminate duplication and overlapping of work in the future.

In 1938, this Mapping Agency faced a dilemma. Maryland was one of the earlier states to be mapped by the U. S. Government, and, in fact, one of the very few states which some 20 years earlier could have boasted that USGS quadrangles at 1 inch to the mile were available for practically its entire area. However, in the course of these years numerous changes had taken place so that many of these earlier maps had become outdated and of little value. Tremendous expansion in the works of man brought about great need for revision as shown by the fact that prior to World War II the latest USGS Baltimore quadrangle showed the City boundary as it was prior to the 1919 annexation.

Very little progress was made in map making for Maryland until immediately preceding our entry into hostilities. At that time mapping received a new stimulus, for with the expectation that maps in the vicinity of Washington might be critically needed, an intensive program was set up and sections of the State were assigned to various Federal agencies for mapping.

Compared with the snail's pace of prewar mapping, the work undertaken by the Army Map Service, Coast and Geodetic Survey, Soil Conservation Service, U. S. Forestry Department, and U. S. Geological Survey was a marvel of modern progress. By the time hostilities ceased, finished maps were published with few exceptions for the entire area east of the 78th meridian. The result is that Mary-

land now has maps, all of which have been revised within a reasonable time, for 80 percent of its land area. By far the larger part of the 80 percent have been prepared at a scale considered impractical as recently as 1940.

West of the 78th meridian there is a very unsatisfactory situation, which is being remedied as fast as funds are made available. No work was done during the war and consequently the latest topographic sheets are those dating from about the turn of the century. Although the mountains have suffered little or no change in the meantime, roads, and other works of man render these maps badly out of date.

The USGS has work underway in Garrett County; however, it appears that Allegany County unfortunately will be covered only to the extent that overlap is necessary in rounding out the quadrangles shared with Garrett County.

In concluding I might add that there is little doubt that presently Maryland is one of the most completely mapped states in the country as a result of extraordinary wartime efforts. However, it is hoped that a vigorous National topographic mapping program will be maintained so that our maps will continue to be kept up to date. What I have said here today should certainly prove to you, if there be any need for proof, that maps are a vital tool in our planning for the physical, social, and economic development of our respective states.

DR. NOLAN: I think all of us could second Mr. Pasarew's hope that our mapping program will be expedited. It will be through the support of people such as you that it may be advanced more rapidly.

The next speaker is also a representative of a state agency that uses topographic maps. He respresents a group that not only uses them but he also represents a group that helps pay for the maps. As probably most of you know, many of the USGS maps are made in cooperation with local agencies, and the state geologists are a group that perhaps are most active in this cooperative field. Mr. R. C. Stephenson, Assistant State Geologist of Pennsylvania, from Harrisburg, is perhaps in an ideal position, since he can speak not only as a partial producer of maps, but also as a user.

He is particularly interested in this general subject, I think from the use angle, and, in fact, is an author on this subject, I understand. He has produced a treatise on topographic maps, their character and use, which was published in the monthly bulletin of the Pennsylvania Department of Internal Affairs last year.

He also, as a representative from Pennsylvania, can tell us something about the very useful study that was made in the state on the needs for maps, which was very beneficial in scheduling new mapping.

Value of the National Topographic Map Series to the Geologist

By R. C. STEPHENSON

ASSISTANT STATE GEOLOGIST, PENNSYLVANIA

BEFORE I go into the subject which I am asked to discuss, I think perhaps I should mention a word about this map classification to which Dr. Nolan referred.

In Pennsylvania, I believe it was in 1945, in cooperation with the State Planning Board and four or five other interested state and industrial organi-

zations, we had a classification of topographic map needs in which a canvass was made of the areas in which the topographic maps were most inadequate, and where we needed the first revision.

Pennsylvania's topographic work is just about completed, that is, the principal coverage. In that respect we are behind all of our adjacent states, namely, Ohio, New York, New Jersey, Maryland, and West Virginia. However, Pennsylvania has a larger area, and one that poses rather difficult problems in mapping. The completion of our topographic mapping is now being carried out in cooperation with the USGS. We are looking ahead, and have already started on a revision of topographic maps, and these issues will be on the scale of 1 : 24,000.

We are also thinking seriously about a State-wide topographic map which is to be 3 to 4 miles to the inch. One other interesting topographic map in the State that perhaps you will be interested in is the eastern extension of the Pennsylvania turnpike, which runs from Middlesex, near Harrisburg, to King of Prussia, which is quite near Valley Forge.

They had prepared in advance of the construction of this route a strip topographic map, contour interval of 5-foot, and the scale, I believe, about 400 feet to the inch. I wouldn't want to be quoted on that, but nevertheless, this was made by photogrammetric methods, using the Brock instrument. I think that job represents the forward looking attitude of this Pennsylvania Turnpike Commission. They have led in highway construction in a number of different aspects.

Mr. Elliot in his paper on the value of topographic maps to the TVA has keynoted the discussion of needs, uses, and benefits of the national topographic map series. The diversified activities of TVA serve well to illustrate the true value of good topographic maps in many fields.

Speaking as a geologist, I represent a field of science which has long championed the preparation of more and better topographic maps. The USGS was created by Congress, March 3, 1879, for the purpose of classification of public lands and the examination of geologic features and mineral resources. Clarence King, first director of the Survey, recognized that the success of these endeavors rested on the availability of topographic maps and formulated a Nation-wide mapping plan. Thus topographic mapping has been a function of the Survey since its inception. Likewise, as in Pennsylvania, the geological surveys of many states have been designated as the authoritative bodies in the execution of topographic mapping functions. In 1885 the USGS cooperated with the Pennsylvania Second Geological Survey in the topographic mapping of the Fairfield quadrangle, one of the earliest of the State-Federal cooperative mapping efforts, now so common.

The configuration of the earth's surface is the result of a long and complex history. This surface has been formed by many superficial processes acting upon widely varying underlying rocks. Topographic expressions of geologic phenomena are invaluable to the geologist in his interpretation of earth history, and the advantage of good topographic maps in geologic investigations is, therefore, obvious.

Engineers, soil conservationists, hydrologists, foresters, militarists and others, who in their activities deal with features of the earth's surface turn to the topographic map for physiographic data—for "terrain appreciation." We see then that a phase of geology, namely physiography, is a principal concern of topographic map users, whether or not they are aware of it.

The accuracy of a geologic map is determined largely by the type and quality of the base on which it is prepared. If a good topographic base is available, the geologist can record the geology accurately in three dimensions. On the contrary, the lack of topographic maps may destroy much of the value of serious geologic effort. To illustrate specifically, the Second Geological Survey of Pennsylvania (1874–1887) produced voluminous reports on the geology and mineral resources of the State. Fundamentally, this work was excellent, but the practical value of the resulting geologic maps was seriously limited by inaccurate horizontal control and little or no vertical control.

The importance of three-dimensional thinking by the geologist cannot be overemphasized. The subsurface picture can be realized only by projection. Surface phenomena are important as a key to subsurface geology. The modern topographic map, prepared by photogrammetric methods and with high standards of accuracy, is a boon to the field geologist. Guided by the success of the topographer in the field of photogrammetry, the modern geologist employs aerial photographs to speed his work and increase its accuracy, but it is still desirable to compile the geologic data on a topographic base.

A recent estimate by the USGS indicates that less than 10 percent of the total area of the nation has been adequately covered by detailed geologic maps. In many cases existing mapping is classed as inferior because of the lack of a topographic base. It is hopeful that more and better topographic maps coupled with improved mapping techniques, such as the use of photogeology, will serve to advance systematic geologic mapping.

CONSERVATION

Our Nation is entering an era of conservation. We are fast learning that we cannot continue wasteful exploitation of our natural resources. To formulate an intelligent program for the conservation of our mineral resources calls for a thorough understanding of the occurrence, extent and grade of these deposits. General geologic mapping affords the only sound fundamental approach to the problem. It is desirable then that State and Federal Agencies cooperate to the fullest extent to provide the topographic mapping necessary as a base for this work.

We must not think of the needs of the geologist merely in terms of those needs expressed by governmental agencies. The greater percentage of our geologists are employed in industry—in petroleum exploration, prospecting for and mining of metallic and non-metallic mineral deposits, and in the rapidly-expanding field of engineering geology. It is essential that the work of these men be assisted in every possible manner, if they are to contribute the maximum to national conservation. The topographic map is a fundamental tool of the geologist and should be available, therefore, for all parts of our country.

From the beginning farsighted persons have recognized the many advantages of a topographic map series for the entire country. The Temple Act, a 20-year plan to complete Nation-wide topographic coverage, was championed by Congressman Temple of Pennsylvania in 1924. Though the act was passed, funds were not provided for execution. As a result, progress on mapping continued at a slow rate. Less than 50 percent of the country had been mapped topographically at the scale of 1 inch equals 1 mile or larger by the end of World War II, and less than 25 percent of the area had been covered by maps adequate for present-

day requirements. In 1946, therefore, the USGS again presented a new 20-year mapping plan. Though the mapping program has been accelerated, the annual effort is still not sufficient to ensure the execution of this plan in 20 years.

As a result of much greater map use during the war years in both military and civilian pursuits, the general public is more map conscious than ever before. If, building upon this foundation, more and more persons are educated to the uses and importance of adequate topographic maps, the Nation-wide coverage may become a reality.

In closing, I would like to say it was this particular aspect—the education of the public to the real value of topographic maps—that prompted me to write this series of rather general articles to which Dr. Nolan referred earlier.

DR. NOLAN: I am very grateful to Mr. Stephenson for presenting the geologist's point of view with regard to map use, because I suspect that some of my colleagues here in Washington have felt that I have been a little overconscious of such use, and have been somewhat prejudiced.

Our next speaker is E. C. Houdlette, Director of the Survey Division of the Massachusetts Department of Public Works. He is well known in surveying and mapping circles, and I gather is a familiar figure at these and other surveying conferences. It is very appropriate that he is here today, because he has been connected with a state that is thoroughly convinced of the necessity for reliable basic surveys and maps, and has followed up that belief with action.

Massachusetts, and Rhode Island, which joins it, are the only States which are completely covered with modern, adequate topographic maps. They were produced as a result of the cooperation between the Federal Government and the State. Not only is Massachusetts completely mapped, but the State is now continuing map activity there in revision. And we are hoping now that we will be able to carry out a revision schedule in such a way that every sheet will be completely revised every 5 to 10 years.

Value of Topographic Maps to the Massachusetts Department of Public Works

By E. C. HOUDLETTE

DIRECTOR, SURVEY DIVISION, MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PREVIOUS to the year 1932 the Massachusetts topographical maps were at a scale of 1:62,500 with contour interval of 20 feet. These maps were made along about 1887 to 1890 and gave a general idea of the topography. They were based on very rough surveys and contained many errors in detail and elevations.

Massachusetts had spent millions of dollars on the extension, improvement and upkeep of its highway system before the publication of the new topographical maps. Much of this highway work had been done with the use of the old 1887 maps and I am confident that we have not, in all cases, selected the best routes. Lack of drainage data caused destruction of bridges, culverts, and sections of road by heavy rains.

I want to state here that previous to the new USGS maps, our survey crew was instructed on any highway survey to go upstream to the next road and get the dimensions of the openings at the road, and that was what was used as a basis for the culverts and bridges of the new road.

LEGISLATIVE ACTS

The Department had not been unmindful of the mapping situation in Massachusetts. In 1932 the legislature passed an act authorizing the Department of Public Works to cooperate with the USGS in the revision of the topographical maps of certain areas and provide for an investigation relative to the natural resources of the Commonwealth.

Section I of this act provided that the Commonwealth's portion of the cost of the revision of the maps should be met by contributions from individuals, associations, or corporations.

Section 2 authorized and directed the department to investigate the need of geological, biological and other scientific surveys of the natural resources of the Commonwealth and to report to the next general court the results of its investigation and its recommendations.

Under this act, of course, no work could be done, because it carried no legislative appropriation, but upon this act the department could recommend to the next legislature, which it did.

In 1933 an act was passed authorizing the department to cooperate with the USGS in the preparation of a contour topographical survey and map of the Commonwealth. The total expenditure by the Commonwealth was to equal the amount expended by the United States but in no event should the expenditure by the Commonwealth exceed fifty thousand dollars in any one year.

As a result of this act, Massachusetts now has modern up-to-date USGS maps at a scale of 1:31,680 with contour intervals of 10 feet available for the entire Commonwealth.

The work of the location and design section has been greatly enhanced by the use of these new topographical maps in studying all possible highway routes between terminal points. Alternate highway route bands are compared and the best route band is selected, considering topography and cost.

AERIAL PHOTOGRAPHS

Aerial photographs supply an up-to-date surface inventory showing the relationship of obstacles (man-made or natural) and are used in conjunction with the topographical map in supplying complete information for the final location survey line.

I want to say here that since I prepared this short paper the legislature of Massachusetts has just appropriated a hundred million dollar bond issue for new highways in Massachusetts. This bond issue, the first of its kind, will be supplemented next year by another hundred million dollar bond issue providing dirt is flying by the time the legislature goes into session next January.

That means a very, very short interval of time. Here it is June, and many of the surveys are not even made. Due to this great rush, we took the new topographical sheets and made a very careful study of various routes for new highways and, on the basis of those topographical maps, we decided which was the best route to build. At the present time, we have completed over a hundred thousand dollars worth of aerial topographical mapping along routes that we had selected by the use of these new topographical maps.

And for, I think, the first time a highway department in the United States has tried it, we are going to endeavor to let contracts with the use of these topo-

graphical maps for grading. These will be on the scale of 200 feet to the inch with 5-foot contours.

If we find we can be successful in letting contracts with these new topographical maps, we can take the preliminary section for pay quantities after the contract has been advertised and let.

In order to obtain full advantages of the use of aerial photography in highway location and design, a contract was entered into between the Massachusetts Department of Public Works and the Institute of Geographical Exploration of Harvard University, The program was arranged in such a way as to obtain data on the most suitable scale of contact prints, focal length of lens, season for photography, mosaics, and methods of presenting topographical data.

MOSAICS

Mosaics show the culture and its relationship to the proposed road, but they convey little information about the topography, which is a most important factor.

Two methods of presenting topographic information with the mosiacs were tried.

A semi-controlled mosaic was laid at a scale of 600 feet per inch so that images of prominent features would fit their positions as determined from a USGS map. The map was then enlarged to the scale of the mosaic and the two were mounted one above the other so that the elevation of any point on the mosaic could be determined by projection.

The second method consisted of laying a mosaic to match a USGS sheet. Contour lines and a few prominent features were traced from an enlargement of the map. These contours were then copied and positives made on process film using a dye coupler developer to give the contours sufficient color to afford contrast. The contoured overlay was then fixed to the edge of the mosaic so that it could be turned back out of the way when not needed, or dropped into position to study the topography. This proved very useful in a number of projects.

I want to say here that another thing that I am boosting my own highway department a little for is what I think no other highway department has attempted. We have just completed a course at Harvard Institute of Geographical Exploration for 75 engineers in the department on the use of topographical maps and aerial photographs, using one in conjunction with the other. And we gave not only lecture periods over there, but we gave actual laboratory work in selection of lines by the use of the USGS sheets and the contact prints.

In conclusion, the new topographical maps of the USGS make it possible to demonstrate that the best highway location has been made and bridges and culverts can be planned in such a way that they will carry off storm water. The cost of replacing these structures will be avoided. Not only will there be a great saving in cost for replacing bridges, culverts, and washed-out roads, but traffic will not be interrupted.

DR. NOLAN: We are now shifting from some expressions of opinion and belief on the use of topographic maps from the state agencies to industry, and our next speaker is Mr. George H. Lacy, who is the Chief Civil Engineer of the Gulf Oil Company of Houston.

He is one of the best known engineers in the petroleum industry, and has long been respected among surveying and mapping people for his enlightened views as to the utility and value of good quality, comprehensive, basic maps.

This is his first attendance at conferences of the Congress on Surveying and Mapping. We hope that he, as well as many other engineers from the petroleum industry, will come back in future years.

Value of Topographic Maps to the Oil Industry

By GEORGE H. LACY

CHIEF ENGINEER, GULF OIL COMPANY, HOUSTON, TEXAS

IT IS an honor to be able to discuss the needs of topographic mapping as related to the oil industry. In reference to Mr. Elliot's paper, I am not qualified to come anywhere near discussing his paper. I am going to confine most of my remarks to Texas and Louisiana, and particularly the coastal region of these two States.

In the early days of the oil industry, the wildcatter was a very colorful figure, and his methods were haphazard as well as crude. For instance, his selection of a drill site was chosen by a flip of a coin, perhaps, or he would sail his hat out, and wherever it hit, he would drill.

Then they had, too, what they called the doodlebug or divining rod, and according to some of the old-timers, they were successful.

Although science has not taken all of the risk out in prospecting for oil, there are very few exploratory wells where the most scientific methods known are not used, and they call on the geologists, the geophysicists, and the paleontologists to furnish this knowledge in trying to find a spot where oil can be found.

This is done by various methods. This group, I am sure, knows more about that than I do—such as gravity measurements, refraction, and reflection seismograph surveys, and core drilling.

It is obvious from the above that accurate topographic mapping of the area in which they are working is invaluable to those scientists. In conducting this investigation by geophysicists, naturally, it is necessary for them to have not only contour maps, but ownership maps.

These men, of course, the geologists and geophysicists, are usually the first on the ground. After they have made their selection upon which to drill or select a block of leases, they need an ownership map. The fact of the matter is they need the ownership map to do the prospecting by geophysical methods, because it is necessary to have a permit to enter on private property.

In compiling the above-mentioned ownership maps, we have found that a topographic map drawn to a scale of not less than 1:31,680, insures the most reliable base and in this area which I am discussing, the contour interval should be at least 1 foot. The coastal area is rather flat, and it takes a small interval to show the topography. With the positions which you have on the contour maps and elevations for ground control, they are a very good base upon which to make an ownership map.

We find that using the quadrangles in conjunction with the aerial photographs is an excellent method of making a map.

The map should show, of course, the artificial and the natural objects, which are a great deal of benefit to, for instance, the scouts, the oil scouts or leasemen. They need this map to go out and hunt the owners of the land in order to secure leases from them.

OIL DRILLING

After a block of leases and the well site have been selected, the next question arising is as to the type of terrain encountered. In this age, heavy equipment is used to drill wells, particularly those at a depth exceeding 10 thousand feet. For illustration, a single unit on our heavy rigs weighs from 20 to 37½ tons. When I say a unit, I mean it is necessary to haul it on one load.

If any of you are familiar with these trucking outfits, you know that they put that unit on, and, if they have a vacant space, they put some more on. Therefore, it is necessary to design roads to support this type of traffic. Also, in designing these roads, as has been pointed out before, it is a great advantage to have advance knowledge of the drainage area to design the size, as well as choose the sites, for the bridges and culverts.

Furthermore, if this particular area is found to be productive, it is necessary to design a system of roads in order to conduct the drilling as well as pick out sites for various camps. If you have a knowledge of the topography, you have the ground before you and you can pick out the site of any structure you want to build.

I might say here that in one particular instance we had a large lease in a river bottom. Fortunately, we had a contour map of that area. We designed our roads. We furnished preliminary estimates. We located the roads on the map, and when the party went to the field and located it on the ground, there was only one minor change made in this whole system. And there were about 15 miles in this one system.

OPERATING OIL WELLS

After the drilling campaign is over we have the problem of operating the productive area. In the operation of the area, we have some waste. We haven't devised the answer yet to sell everything we get out of an oil well.

We get what we term sweet water or salt water, and various chemicals, I don't know just what, that have to be disposed of. With a topographic map of this area, we can design a system of gravity flow from the tank batteries. That is where the water is separated from the oil. They have two methods of disposing of this water. One is what we call injection wells. These wells are drilled into some porous sand below the fresh-water sands, and the water is then injected into these wells. The other method is earthen storage. That is not as satisfactory as the injection wells.

I might tell you a little story if we have time.

It seems that a fellow walked into a bar and wanted the largest drink that they had, and the bartender asked him what he wanted in it. He said, "Just put in anything, bourbon, scotch or anything you have, and after I drink it I will tell you what was in it."

He fixed him up. He put a half-dozen or so ingredients in there, and this old boy drank it and said, "All right," and he named each one off correctly.

The bartender shook his head and said, "I can't understand that, will you have another one?"

He said, "Yes, fix me another one, but put something else in, and I'll tell you what is in it."

This bar is down in south Texas, where they have a lot of this waste water, so the bartender sneaked back out there and got some of the waste water and put it in a glass and set it out, and this old boy tasted it and shook his head, tasted it

and shook his head, and he said, "Well, I don't know what is in it, but it won't sell."

So we can't sell this salt water.

I didn't mention the pipe line. The pipe line is a very important thing in the oil industry. We have to transport this oil. As you know, the Big Inch line goes up to here in the East. The location of that type of project is a major job; it is a very expensive one, and in order to construct and operate these lines efficiently it takes a lot of planning.

With adequate topographic mapping over the route, and aerial photographs, you can locate this line in the office, select your camp sites and pump station sites, and when the engineer goes into the field he has practically the same knowledge as though he had covered that entire territory before. I don't think there is any use to bring that out, but that is one of the greatest helps, I think, that maps offer in our industry.

In concluding, I would like to say this. I think Mr. Stephenson mentioned that the public is not educated to the use of topographic mapping. I know in Texas we are in terrible shape. You heard the lady this morning. Massachusetts is so far ahead of Texas it is just a shame.

In reviewing the progress of the oil industry, it does not seem to me that mapping has kept pace with the methods of drilling, producing, and refining. At great expense the industry has done some of its own mapping, but this covers such a small area—only that area thought absolutely necessary to carry on operations. Several years ago the State of Texas had in operation a Reclamation Department, which, among other things, carried on a very good program of topographic mapping. However, for some unknown reason this Department was abolished, and since that time there has been nothing done in the way of mapping by the State.

DR. NOLAN: I think the Congress has been inspired by the speed with which Texans always do things, and the vast expanse of their territory. We were very anxious to make sure that Mr. Lacy wouldn't go home without having become a member of this organization, so they have now produced a membership card, having duly elected him.

The next speaker is also a representative of the industrial use of topographic maps, especially in the field of public utilities. He is Mr. George R. Rich, who is a public utilities consultant of the firm of Charles T. Main, Inc., of Boston. He has a sort of double field of experience in that he was the chief design engineer for the TVA for a number of years and also served in the consultant field with Stone and Webster. His present firm, Charles T. Main, Inc., is an internationally know firm of consulting engineers.

We would like to hear from him on the subject of how useful our topographic maps are.

Value of Topographic Maps to the Public Utilities

By GEORGE R. RICH

PUBLIC UTILITIES CONSULTANT, CHARLES T. MAIN, INC., BOSTON

THERE IS just one point that I would like to make, and that is that I am particularly intrigued by the point both Mr. Elliot and Mr. Stephenson have made, in reference to the geologic implications of these topographic maps.

One of the most useful things I have in my office is a bedrock contour map prepared by that eminent old geologist, Professor W. O. Crosby, about the turn of the century. It covers the shoreline of Boston and the area back in the hinterland, for, oh, say a square 40 miles on each side. It shows 40-foot contour intervals on bedrock, and, in appropriate shading, the nature of the geological formations underneath.

I have had occasion to use that map on about five jobs in the last year. I have had a lock and dam, a bascule bridge, a large central steam generating plant, a pier, and a pretty good sized bridge on another project. It is just an indispensable tool.

I don't for a minute advocate mapping every square foot of land in the country to show bedrock geology by any means. But I do think that there are certain strategic areas, probably in the vicinity of the cities, where we might do something along this line which would pay rich dividends. I am thinking particularly now of a job I am working on. It is for the New York water supply.

Here is the essence of the thing. I don't happen to be a specialist in surveying, but I think just a few words about this will show you the magnitude of the quantities involved, and the scale of things that are affected by modern surveying, and I think it will illustrate very forcibly the need for bedrock contours. (Slide shown.)

This is a map of New York. To augment its water supply, the City of New York has gone to the headwaters of the Delaware River and built three reservoirs: the East Delaware, one on the Neversink, and one on Rondeau Creek which discharges into the Hudson.

It happens that the downstream reservoir, the Rondeau, is something like 500 feet static head lower than the other two, so that this water that is collecting in the outer reservoirs will be discharged in tunnels into this Rondeau reservoir. From that point, then, there will be 85 miles of tunneling in rock to New York. That is not my job, that is the New York water board's job.

Here is where we come in. The energy of efflux of the water from these tunnels is capable of generating power. In condemning these sites for drinking water, the City of New York did very serious damage to the potential power properties of two local utilities, the Central Hudson Gas Company and the Rockland Light and Power Company.

Ordinarily that would have involved the companies in a lawsuit to recover damages, but in this particular instance they did a rather unprecedented thing. They got together. The lawyers, instead of staging a court case, got together, and essentially, here is the agreement:

The City of New York will allow the utilities to build power stations in the tunnel outlets, one by each company. One tunnel is 5 miles long; the other is 26. So the City of New York will give the water and the permission to build the power plants. The two utilities will build the power stations.

And here is the third element. At the end of 50 years these two power stations will revert to the ownership of the City of New York. That is the essence. The details, of course, were worked out very elaborately. You can see at a glance how every step of this planning requires knowledge not only of surface topography. These tunnels are drilled in rock. They are pressure tunnels, concrete lined. This one to New York is 85 miles long,—these other two power tunnels, 26 and

5 miles. The estimate of this project back in 1930 was over 300 million dollars. I would hazard a guess we are talking about a 500 million dollar job.

In planning these earlier tunnels, Mr. Eide of the New York board told me that at the time they were ready to build the Catskill Aqueduct to New York, from the Catskill system, they didn't have one single bit of knowledge of the elevation of bedrock in the Hudson River from Albany all the way to New York.

Of course, that was 20 or 25 years ago. But I think that is rather an amazing thing, that here in this great metropolitan area we didn't know much of anything about the bedrock.

I would just like to leave that picture with you, of this crying need for knowledge of where the bedrock is under the river, what the nature of the geologic formation is, and I don't know anybody who could do that job to perfection any better than the USGS.

DR. NOLAN: It is very nice to hear such things. We are getting a little short on time. We have four more speakers on the schedule, so I hope we can perhaps move along a little bit. I will do my part by saying that the next speaker doesn't need any introduction in Washington. Mr. Helmuth Bay, the Washington representative of Rand McNally, is probably as well known here as his company is all through the country.

Various Uses of Commercial Maps

By HELMUTH BAY

WASHINGTON REPRESENTATIVE, RAND MCNALLY COMPANY

I AM going to deviate a little bit from the subject, perhaps. We don't make topographic maps, but we use them. We have used them, you might say, ever since we have been in the map business, and you can't make too many of them to suit us. So I am going to talk a bit about the uses to which people put maps made by commercial map makers.

It is a subject that is very difficult to classify, and to discuss systematically. Broadly speaking, I think, they can be said to fall into three large fields:

1. Maps used in business and industry.
2. Maps used for educational purposes.
3. Maps used by individuals for their own personal requirements.

MAPS FOR BUSINESS AND INDUSTRY

In the first field, that of business, only someone who has been actively connected with commercial map making, or one who has run a large map library, can begin to appreciate the thousands of uses to which business men put their maps.

Most successful business houses, large and small, use maps on which to better visualize their varied activities in the same way that engineers use their blueprints. Marketing research studies, routing of salesmen, location of sales territories, agencies, potential sales, or branch offices—these and many allied phases, are generally worked up or laid out on maps. Needless to say the demand for map bases on which such studies can be made vary greatly. Some wish black and white maps showing only cities or cities and counties. Others want the railroads

shown, or perhaps only the highway net. Freight zones, commercial zones, steamship lines, navigable streams, trading areas, air lines, bus lines,—you could enumerate such varied features for an hour or more.

Scale demands also differ, of course. Some people want detailed street maps of cities and vicinities, others extremely generalized maps. There are also many requests for maps showing only sections or portions of a state or county.

Another use involves maps for promotional or advertising activities, although here we find many of them made up specially to indicate the story.

In addition to individual maps there is also a large variation in the demand for atlases. This may be based on size, content, or both. Population figures are usually always required, as well as transportation facilities, statistics, or economic data. It is also required that they be up to date, a quality that is of extreme importance to the American business man. As an example of this, if we are a bit late in bringing out our Commercial Atlas in which we make about 25,000 corrections annually, we receive many letters or 'phone calls asking when the new edition will be ready.

Another point which I would like to make here is that maps used by commercial firms engaged in international activities must be up to date with the current political situation. For this reason most commercial map makers show the de facto boundaries which may or may not have international recognition. A business man is interested only in determining the actual and realistic situation he must face in his business relations abroad and not in diplomatic positions.

MAPS FOR EDUCATION

Maps used for educational purposes can be far more easily classified or grouped than the maps in the other two fields. That is due partly to the fact that the majority of them are made in accordance with basic specifications recommended by the educators themselves. In other words, the teachers make known in a general way the sort of maps they wish to use and the mapmaker then attempts to comply with their wishes when he brings out his product.

For the study of geography, proper physical, political, or physical-political maps are generally used. By physical-political I mean a map showing both physical and political features. Important here are legibility, color, and simplicity of content, particularly in the case of wall maps. Used also are special maps showing history, economics, climate, soils, meteorology, and numerous other phases of our environment that are discussed.

Black and white maps are also extremely important to education and the demand for kind and locality varies greatly. They are used as bases upon which the students can work out and depict the research projects they may be assigned. Special and detailed maps are also extensively used in education, but largely for reference purposes. Globes and atlases are, of course, also very important in educational work. Maps are widely used in the social studies texts to aid the student in the visualization of the subjects treated.

MAPS FOR INDIVIDUALS

As regards the requirements or uses which fall into the last-named field, I hardly know where to begin. I really believe that if you look up a word in the dictionary and made a map of its definition, sooner or later someone would be sure to come along and buy it.

First in importance I think is the use of maps by individuals for travel purpose. The American is a great traveler. If he has a week end or a few days' vacation he may be 500 miles away from home on the evening of his first free day. Californians move to the East Coast in the summer by train, plane, bus, or car. In the winter the folks of the East reverse the procedure.

Millions of miles of travel are made by motor car and for this the driver wants a road map. Some want a map showing only the highways and their numbers, others want them embellished with points of scenic or historic interest. Occasionally you find an individual who desires to have hiking trails in scenic regions included. It might be of interest for some of you to know that the commercial map makers publish about 100 million road maps each year, most of which are distributed by the oil companies.

Reference atlases and maps for home use constitute another large division of the field, and here again the demand is extremely diversified. Size of volume and quality of detail are the general factors which determine selection.

Just to enumerate some of the other uses to which individuals put their maps let me mention a few:

A lady wishes to decorate a den or recreation room with pictorial maps.

A gentleman would like a set of up-to-date highway maps of Latin-America.

An ex-soldier wants a highly detailed map of an island or country he fought in during the last war.

Someone requests an aerial photo with street names added of a section of Pittsburgh in which he lives.

An individual is going to the Belgian Congo and requires detailed road maps.

A traveler is making a world cruise and wants a small but very complete pocket atlas.

A geneologist wishes maps to aid in tracing family history.

And one request that I had (I like this one) was for a map of Europe and a map of the World, similarly colored and both on the same scale, to fit a built-in alcove of a certain size.

In conclusion, I would like to point out that the problems of the commercial map maker are far more numerous and varied than they are in the Federal agencies. In the case of the last named—the Federal agency—it usually has certain specified map assignments to carry out. Standards can be set up in most cases and once established the work proceeds on a predetermined schedule.

The commercial map maker, however, is constantly requested to bring out new and different maps. Every size and kind of map must be considered, and being forced to include the profit angle he must carefully evaluate his market or the demand before bringing out a new one. His standards are few, quality of detail varies immensely, color ranges are extreme, corrections must be faced frequently, and changes in the national and international political situations must be carefully followed.

Commercial map makers are greatly dependent upon the government's large-scale maps as bases from which they can make their smaller-scaled ones. Being closer to the public from the standpoint of knowing and learning what people want in the way of maps, they feel a heavy responsibility in trying to keep the supply adequate and varied. For these reasons, the commercial map firms wish to see the large-scale topographic mapping projects of the Government completed as soon as possible and stand squarely behind them in their efforts to secure support to this objective.

DR. NOLAN: Again we are grateful for this expression of support from commerical map makers. I think that the Government map makers and the commercial map makers supplement one another's activities very, very nicely.

I was tempted to say a little more about the next speaker, because he comes from my home state; but again, in view of the time, I will simply introduce Mr. Warren Creamer, who is Director of Engineering and Construction in the Connecticut State Highway Department.

Value of Topographic Map Series in Highway Engineering

By WARREN CREAMER

DIRECTOR, ENGINEERING AND CONSTRUCTION, CONNECTICUT HIGHWAY DEPARTMENT

I AM afraid this is going to be rather elemental. It has one virtue—brevity. The National Topographic Map Series is the most basic essential for planning highways and bridges. Without these maps it would not be possible to properly conduct the required steps leading to the development of a well planned, correctly integrated, and well constructed highway system.

In view of the time limits imposed by the obvious dispatch needed in a symposium of this nature, the following uses are mentioned without elaboration. It is indeed a very great service which the USGS has provided the highway engineer.

ADVANCE HIGHWAY PLANNING

The maps indicate areas to be covered by aerial topographic surveys generally after the approximate location of the proposed route has been determined from information shown on these maps.

They are used to obtain approximate profiles for reconnaissance purposes, often after the maps have been enlarged for greater clarity.

They depict alignment features in a general but very effective manner.

They are used to display in an approximate manner the methods designed to connect existing highways with the proposed facilities.

They permit of developing approximate quantitative estimates for arriving at the capital cost of various possible routes between an established origin and an established destination. In most cases during the early study of a project no other maps are available for such use. The maps, therefore, are the most basic of all known aids in planning our national highways and bridges. Special display sketches showing tentative alternate schemes for highway relocation projects may be prepared using these maps as a base. The mapping section of the Connecticut State Highway Department's Bureau of Highway Planning has used the National Topographic Map Series as a reference for street alignments, nomenclature, water features, boundary lines and various other items of culture data which they wish to incorporate in their finished maps.

SURVEY AND DESIGN

For highway location work these maps provide a convenient base map for reconnaissance and are invaluable during preliminary investigation of alternate routes. They give the locations of saddles, bluffs, swamps, ridges, valleys, favor-

able and unfavorable stream crossings, and other physical controls, providing basis for measurements of distance, approximate alignment, rise and fall, and approximate gradient for comparative studies of alternate routes. They also provide a basis on highway design for the determination of characteristics of drainage areas including length, width, fall and run-off characteristics as required for bridge and culvert designs.

SOIL MECHANICS

The topographic quadrangles identify land forms and soil and rock types. The manner of deposition frequently indicates the composition of soil and rock. For example, long finger-like ridges running in approximate north-south direction are probably eskers if located in glaciated country such as northern United States. In glaciated country, also, a meadow having a nearly level surface is undoubtedly a glacial lake deposit and therefore will contain uniformly graded soil such as fine sand and silt and coarse sand and gravel.

The form of surface often indicates the type of erosion which in turn is generally governed by the type of soil. For example, rock, granular and semi-granular materials assume the steepest slopes, while clayey soils have "softer," flatter slopes. Cliffs are always of rock. A ridge with both sides steep indicates an igneous dike, while if both sides are rather gently sloping, a ridge of soft rock such as an uptilted or folded sedimentary formation may be indicated.

Topographic maps depict the location of swamps and marshes. They may have deep or shallow deposits of soft soil. Soils investigations will disclose the nature of such deposits. All of these uses serve to inform the highway engineer and designer of the probable lands forms to be encountered in any specific tentative or final establishment of a location line.

BRIDGE DESIGN

Topographic maps give a clear indication of the topography and works of man in the vicinity of any project, so that when bridges are considered, the impact of such structures upon the influencing characteristics of the terrain can be correctly and accurately assessed. They are of fundamental value in determining the watershed areas to be considered in the design of bridges over streams.

The contours indicate the ruggedness of the country considered in such watershed and are of material assistance in determining the factors to be used in the run-off equation.

These are by no means all of the services performed by these excellent topographic maps but they serve as illustrations of some of the most important.

DR. NOLAN: That was a very valuable summary of the use of maps in highway construction, and I hope as a result of personal experience next week to see how effectively they were used on the Hudson River and the Merritt Parkway.

We have a substitution in the program. Originally we were scheduled to hear from Mr. D. J. Guy, who is Manager of the Natural Resources Department of the U .S. Chamber of Commerce. We are fortunate to have as a replacement his assistant, Mr. Smith—fortunate, because I think he can present a point of view and a state of mind that reflects not only private industry as presented by the Chamber of Commerce, but also a State, since he is the former state geologist of Georgia, and the Federal Government, as a former employee of the Bureau of Mines.

Value of Topographic Maps to Business

By R. W. SMITH

NATURAL RESOURCES DEPARTMENT, U. S. CHAMBER OF COMMERCE

THE Chamber of Commerce of the United States is the organization through which local and state chambers, trade associations and business men, working together, contribute their time and thinking to help in the solution of national problems. It has an organization membership—chambers of commerce and trade associations—of over 3,000, with an underlying membership of over 1½ million; and in addition to the organization members, it has 19,000 business members. It represents all business, big and small. In fact, about 80 percent of its members are small business men.

The segment of business covered by the Chamber's Natural Resources Department, of which Mr. Guy is Manager and I am Assistant Manager, covers the extractive industries—mining, fuels, forestry, water, power utilities, grazing, public lands, national parks, etc. The staff of the Department has the advice of the Natural Resources Committee, composed of 43 leaders in these various industries. These men draft the policy declarations on natural resources that are adopted by the organization members, either by referendum or by vote of the delegates at the Annual Meeting of the Chamber.

It would be hard to find a single natural resource industry that has not, at one time or another, had need for accurate topographic maps. The mining industry uses them for locating mineral deposits, for base maps for geologic mapping and prospecting of the deposits, for planning the mining and the disposal of overburden and tailings, for locating mill sites and developing water supplies, etc. You have already heard from Mr. Lacy how the petroleum and natural gas industries use topographic maps.

The forest industries use topographic maps and aerial photographs for cruising and estimating timber, for planning logging operations including the planning of sustained yield operations, and for locating access roads and mill sites. Much progress has been made in recent years in the use of large-scale aerial photographs for estimating timber. With practice the different species of trees can be recognized on the photos and the size estimated.

The electric utilities need and use topographic maps in the planning, design, construction, and operation of their hydroelectric, steam-power, and transmission and distribution systems. Many of these uses have been enumerated by Mr. Elliot of the TVA. In fact, the TVA, having virtually completed the development of its river system, has become largely an electric utility with steam plants as well as hydroelectric plants.

The larger companies in these various industries make or have made their own topographic maps on scales to suit their various purposes. But the smaller industries are dependent upon the standard topographic maps made by the USGS and the Army Engineers. Where these are available they are used, but where not available the industry has to go to considerable expense to make its own surveys, usually an inferior substitute, or else takes the gamble of making its investment with inadequate data. Numerous examples could be cited of costly mistakes that could have been avoided with adequate topographic maps.

For this reason, the Chamber of Commerce has long advocated the rapid com-

pletion of the standard topographic maps of the United States. Our present policy declaration on this subject, adopted in 1947, reads as follows:

> The Federal Government's program of topographic mapping should be pursued at a rate that will complete the topographic mapping of the United States within 20 years.
>
> The mapping activities of all Government agencies should be coordinated, as far as possible, into a standard topographic mapping program by a regularly established agency, such as the USGS, in order to void duplication of effort and waste of public funds.
>
> The long-established principle of State-Federal cooperation in topographic mapping should be encouraged in every way possible.

To show business men the need for topographic maps and the slow progress that is being made in completing the topographic mapping program of the United States, the Chamber's business magazine *Nation's Business* published an article 2 years ago called "Columbus Would be Disgusted." The article was very popular and many reprints were distributed.

The Chamber is much interested in the public lands of the Federal Government, made up of what is left of our original public domain and the acquired lands. Few realize that the Federal Government owns about 25 percent of the land area of the United States, and that the percentage is steadily growing by the purchases of some 30 or 40 Federal departments and agencies. Few of us in the East know that some 54 percent of the 11 Western States is in Federal ownership. The percentage of individual States range from 35 percent of Washington to 87 percent of Nevada. No wonder that Nevada, with 87 percent of its land removed from State and local taxation has to legalize gambling to obtain revenue.

Largely because of these large Federal holdings in the West, the Western States have not had sufficient revenue to participate as fully as the Eastern States in the State-Federal plan of cooperative topographic mapping. They have not had the benefit of increased federal expenditures based on their percentage of public land as has the Federal Roads Program. As a result, the West is largely unmapped.

The Nation is now engaged in a greatly stepped-up program of river-basin development, principally in the Missouri River Basin and in the West. To show you the extent of this program for reclamation, flood-control, navigation, and power projects covering all of the river basins of the country, I quote from figures furnished Senator George W. Malone by the Chief of Engineers:

Federal River Basin Projects	*Estimated Cost*
Works already completed	$ 4,779,700,000
Projects under construction	4,593,000,000
Projects definitely planned	18,980,900,000
Projects planned for the long-range future	29,152,600,000
Total	$57,506,200,000

The Chamber of Commerce favors the development and conservation of the water resources of the nation upon sound engineering and economic principles, including the expenditure of public funds upon carefully planned projects which will stand the test of economically sound investments. The Chamber believes that many of the projects whose total estimated cost is given above will not meet these tests because they are based on inadequate data—lack of topographic maps, rainfall, stream flow, and other data necessary to determine if they are sound both in respect to engineering and economic feasibility.

The Hoover Commission Task-Force Reports on Natural Resources and on Public Works both point this out clearly, with examples. The most sound and vitally necessary recommendation of the Hoover Commission regarding public works in my opinion is not the proposed shotgun wedding of the Army Engineers and the Bureau of Reclamation, which both Bureaus are vigorously fighting, but the proposed independent and non-political Board of Review to pass on the engineering and economic feasibility of all projects, whether in the planning, authorization, or appropriation stages. Clearly, without adequate basic data, including topographic maps, such a Board of Review would be greatly handicapped in appraising the value of many of the projects submitted to it.

The country would be far better off if we were to accelerate the expenditure for accurate topographic maps and other necessary engineering data rather than to rush into an accelerated but poorly planned program of river basin project construction. The benefits to be derived from river basin development are in direct proportion to the sound planning on which they are based. The first and foremost need for such sound planning is adequate topographic maps.

DR. NOLAN: I am glad Mr. Smith brought up the recommendations of the Hoover Commission, because many of us here in Washington are very pleased to see what would seem to us rather belated recognition of the fact on the part of high authority in government, and the country as a whole, of the need for basic information before embarking on so many of these larger projects that we are undertaking. At the risk of embarrassing our first speaker, I would say that I think the TVA group is outstanding as an example of getting that type of information.

Our final speaker is a visitor from the north. He is Mr. H. E. Seeley of the Dominion Forest Service of the Department of Mines and Resources in Canada. He is the president this year of the Canadian Institute of Surveying, so I think we will be doubly pleased in hearing from him, both as a surveyor and as a forester, in the use of topographic maps.

Value of Topographic Maps in Forestry Work

By H. E. SEELEY

DOMINION FOREST SERVICE, DEPARTMENT OF MINES AND RESOURCES, CANADA

I AM very glad to be here, and to listen to so much that is of great interest. I will try to deal briefly with certain forestry aspects, as we have them in Canada.

The preparation of a national topographic series of map sheets by regular quadrangles in accordance with latitude and longitude, often constitutes most of the spadework in the production of special resources maps such as forestry maps. Not only do they provide a base on which to establish the network of forest type lines but also without further ado they are of prime importance to the forester as a guide to routes of travel and accessibility of timber. Another point is that the importance of contour lines in relation to the cutting and transportation of wood should not be overlooked.

In the case of Canada, the Dominion Forest Service has been instrumental in investigating the value of a series of published forestry map sheets which

makes special use of and is largely dependent on the National Topographic Series. This is possibly a unique effort, and the scheme anticipates the coverage of the country by published forestry maps in a manner hitherto reserved for topographic, geologic, and soil maps. Whether a full program is set in motion remains to be seen. In this plan forest inventory maps are produced by photolithographic methods off the press. The maps are prepared by the aid of air photographs and provide general information as to the type, height, and density of each subdivision of the forest. It was found that by virtue of the special map-making facilities available in the offices of the Dominion Government in Ottawa, these photolithographed forestry maps could be made at an especially cheap rate. By utilizing prints taken from the plates of the topographic series, the draftsman saved the time that had previously been spent in redrawing and re-lettering the features that appeared on the topographic maps. The old method, which is still used when convenient, consists usually of the making of tracings and printing on sensitized paper. Furthermore, the prints which are obtained off the press are of a higher standard than those on sensitized paper, particularly in regard to coloring, shrinkage, durability and fidelity of detail.

A saving which is often valuable is introduced in the coloring of the maps, whereby in a single step color plates are made which will serve for thousands of copies, whereas in hand coloring a corresponding step must be carried out for each additional copy. Coloring is of particular importance in the case of forestry maps.

Furthermore, quantity production of map sheets becomes possible because of the relatively negligible cost of printing additional copies.

These published forestry maps were prepared at the scale of 1 mile to 1 inch, which is fortunately a favored scale for the publishing of the topographic sheets on which they are based. Of course, detailed forestry maps are still being prepared at large scales by the older methods.

I might say that I have on hand a sample copy of the published forestry maps to which I have referred, and also a copy of the key to our national topographic series.

DR. NOLAN: Mr. President, I had hoped that we would get the program through in time to have some discussion from the floor. I had particularly hoped to call on some of the people in the audience. But I understand from the committee that we are supposed to be through by 5 o'clock, and I at least have succeeded in doing that.

Mr. President, may I turn the meeting back to you? Before I do it, I would like to thank the Congress on my own part for the opportunity to benefit from the discussions this afternoon, and to listen to the reasons why we should have more topographic maps; and I should also like to express my thanks and appreciation to the very busy people who came here to tell us about it.

PRESIDENT WRIGHT: On behalf of the Congress, I wish to express our appreciation to Dr. Nolan and all the members of this symposium for presenting the papers that they did this afternoon. I am sure that they will be printed in forthcoming issues of SURVEYING AND MAPPING, and they will reverberate throughout the entire membership.

Forty-third Annual Meeting, Canadian Institute of Surveying and Photogrammetry

By S. A. BAUER

PRESIDENT, AMERICAN CONGRESS ON SURVEYING AND MAPPING

AS PRESIDENT of The American Congress on Surveying and Mapping, I was invited to be a guest of The Canadian Institute of Surveying and Photogrammetry at its forty-third annual meeting in Ottawa on February 1st and 2nd. I was also asked to read a paper entitled "Practicing Surveying in the United States."

Arriving in Ottawa, I was shortly greeted by our very good friends, Mr. C. C. Lindsay and Mr. H. E. Seely, who thereupon introduced me to numerous surveying officials of Canada. I was further pleased to see among those present our own vice president, Helmuth Bay, and fellow members, P. G. McCurdy, president of The American Society of Photogrammetry, and O. S. Reading, president of the International Society of Photogrammetry.

The meeting was a pleasure to witness, in the smoothness of its operation, in the enthusiasm of its members, and in the apparent expertness of so many in the various phases of surveying, photogrammetry and electronics. It was interesting to see the almost complete coordination that exists in Canada between photogrammetry and all phases of surveying. Apparently photogrammetry in some phases is an established and recognized routine part of most surveying operations in Canada. In this respect, Canada is far in advance of the United States, where photogrammetry is still somewhat in the process of proving itself to the practicing profession and the public.

Canada is also far in advance of the United States in organizational recognition of the profession. There is an apparent greater supervision of the practice, both for those contemplating certification into the practice and those already practicing. Each province has its land survey office, in addition to that of the Dominion, through which surveys must be routed for inspection and check. Each province seems to have its own land surveyors' organization, which works in close conjunction with The Canadian Institute of Surveying and Photogrammetry.

It was an eye-opening experience to see the close integration of the profession and the results that can be obtained through proper organizational activities within the profession over an extended period of years. The American Congress on Surveying and Mapping will do well to pattern its activities, as far as possible, on those which have built up the closely knit profession that exists among our Canadian friends, in order to bring the general level of practice in our country to an equivalent uniform level of understanding and cooperation.

The Size of Lettering for Maps and Charts

By ARTHUR H. ROBINSON

ASSOCIATE PROFESSOR OF GEOGRAPHY, UNIVERSITY OF WISCONSIN

LETTERING is one of the more important aspects of cartographic methodology. Probably because words and letters are such familiar shapes, their utilization has received much less than its proper share of attention in cartographic literature. The subject apparently lacks the imaginative appeal of problems such as color, projections, landform representation and some others; but from the point of view of functional significance, lettering frequently outranks them. No matter how well designed a map may be in other respects, it fails if the lettering it depends upon for the transmission of its information is treated improperly. Prof. Goode summed up the general problem in a statement which might well be adopted as a cartographic principle: "Insofar as any data on a map cannot be grasped by the eye and easily read, in just that measure is the map encumbered with useless material, and is a failure."

Lettering is paradoxical, being at the same time simple and complex. This is partially due to the fact that letter-forms, themselves, that is the fundamental shape of an *A* or *M*, are well known and are rarely rendered in such a manner as to make their shapes unrecognizable. On the other hand, the method of rendering the shapes may make them difficult to see, or ugly and unpleasant, or so prominent that they dominate equally important map data. The list of topics included in lettering methodology would contain such headings as type faces and their design relationships, legibility and visibility of faces and sizes, relation of faces to map texture and subject matter, color of print and background, and many others of lesser importance. Size of type is of outstanding significance, however, for although the others may be more important on particular maps, size is paramount on every map.

SIZE OF TYPE

Perhaps the commonest kind of decision which must be made by a cartographer concerns the size of lettering to be used for the great variety of items which must be named on maps. Specifications for lettering are usually based on the size of the thing to be named or the space to be filled, and must be graded with respect to the total design and intellectual content of the map. Much of the criticism, however, conscious or unconscious, that is leveled at map lettering is aimed specifically at its size—or lack of it. There seems to be a widespread tendency among map makers (amateur and even some professional) to overestimate the ability of the eye and to underestimate the effects of reduction.

Size of lettering or type face is designated by "points," one point being nearly equal to 1/72 inch. Lettering that is 1/4-inch high is equal to 18-point type. Reduced by one-half, it will be roughly equivalent to 9-point lettering, although not the same as 9 point since most type sizes in a font (all sizes and forms of one face) are designated separately for more perfect balance than would be produced by simple enlargement or reduction of one design.

RELATIVE VISIBILITY OF TYPE

There have been quite a number of studies of the relative readability of type sizes in the past half century, but most such studies are somewhat limited in their

application to the specific problems of cartography.[1] Of much more significance to cartography are the variations in visibility and legibility between type faces and type sizes. Precise studies have been made by Luckiesh and Moss based on medically sound determinations of the ability of the eye.[2] Assuming no other complications (and the assumption is a bit unreal) the eye reacts to size in relation to the angle the object subtends at the eye. With normal vision an object which subtends an angle of 1 minute can just be recognized. Letter forms are complex, however, and it has been determined that about 3-point type is the smallest just recognizable at normal reading distance. Normal vision is, however, a misnomer. It certainly is not average vision. One would be safer to generalize that probably 4-point or 5-point type comes closer to the lower limit of visibility for the average person. Many maps, and especially atlases, approach this lower limit and frequently persons find a reading glass to be a necessary accessory to the use of an atlas. Under some circumstances this cannot be helped, for in the last analysis type sizes of the smaller categories are economic necessities for atlases. A publishing house does not have unlimited funds for the production of the number of large-scale maps necessary to utilize larger type sizes, and the bulky volumes, if so made, would probably not be accepted.[3]

Of more significance to cartography are the determinations of Luckiesh and Moss regarding the relative visibility of type. By means of a specially constructed "visibility meter" they have adduced the data shown in Table 1. The

TABLE 1.—*Relative visibility of type size*

Size in points	Relative visibility	Size in points	Relative visibility
3	1.10	10	4.65
4	1.60	12	5.66
5	2.11	14	6.67
6	2.64	18	8.67
8	3.64	24	11.68

table was prepared by rating the tests of one font at normal reading distance with test objects of simple design which subtended known angles and had been rated in visibility.

The table may be used as a kind of yardstick of prominence for the smaller sizes, that is 10-point type is roughly 4 times more visible (or prominent) than 3 point. It should be noted that the relationship is not arithmetic but approaches the logarithmic. This, of course, does not continue indefinitely. As a matter of conjecture, ratings much beyond 24 point would probably have little validity

[1] PATERSON, D. G. AND TINKER, M. A.: How to Make Type Readable. New York, 1940. These two psychologists have made extensive studies and this is a summary of their conclusions. It contains an extensive bibliography and is of great value to the study of the subject.

[2] LUCKIESH, M. AND MOSS, F. K.: The Visibility of Various Type Faces. *Journal of the Franklin Institute.* Vol. 223. pp. 76–82.

Idem. The Quantitative Relationship Between Visibility and Type Size. *Op. cit.* Vol. 227, pp. 87–97.

[3] It is a curious but distinct possibility that many of the smaller names on some atlas maps have never been read by anyone but the map maker.

since anyone who can't see 24-point type would be rated as blind, while visibility in the larger sizes would be more dependent upon other factors than size.

Within the narrow limits prescribed by the familiar "all other factors being equal" the table provides the cartographer with a scale by means of which he can select relative sizes in accordance with the intellectual significance he assigns to the different names appearing on a map. It can rarely, if ever, be exact for in many cases it is quite impossible to be precise in the determination of relative significance in the map design and because so many other factors of design are operative in producing the final "total" impression. But at least in his "visual outline," or plan of using media and technique, he need not double the point size to make a name twice as "important."

SELECTION OF TYPE SIZE

Regardless of the interesting possibilities suggested by the foregoing for the more precise methodology of type use on maps, by far the most important aspect of type size at present is the simple question, "Can the observer read it at all under the circumstances?" Frequently, map makers, surveyors, analysts, and others are called upon to prepare presentations to classes, juries, policy makers, and other such groups. They must face the question, "What is the minimum type size legible (under normal conditions) on a wall map or chart from the back or middle of a 40-foot room?" Or, "How large should the lettering be on a graph or map which is to be made into a slide and projected in an auditorium?" These are routine questions of considerable significance since they confront anyone who prepares or uses graphics. Teachers need some kind of yardstick to evaluate lettering on wall maps while the map makers need some basis for choosing lettering sizes.

The determination of tables of equivalents is relatively simple. There are, however, so many possibilities of changes in visibility and legibility due to other factors such as variations of type design, lowering of background contrast, or confusing textural conflict, that any such simple tables must be used cautiously. Two types of tables are here presented, one for maps used in the original or in reduced form (Table 2), the other for maps enlarged by projection (Tables 3–9).

FOR MAPS IN ORIGINAL

Table 2 is based on the assumption that if a particular point size at normal reading distance from the eye (18 inches) subtends a certain angle at the eye, then any size lettering if viewed at such a distance as to subtend the same angle is, for all practical purposes, the same size. Thus, 144-point lettering at 30 feet from the observer is the same as 8-point lettering at normal reading distance, since each circumstance results in the same angle subtended at the eye. It will be seen from the table that legibility diminishes rapidly with distance. Any lettering of 16-point size or smaller cannot be read even at 10 feet from the chart or map. Even letters 1-inch high can be read from a distance of 40 feet only by a person with above average vision. To those with average (not normal) vision such letters are likely to be illegible from 25 feet.

FOR MAPS PROJECTED ON SCREEN

Another type of table is required to answer the questions which arise when maps and diagrams are to be reproduced on slides and then projected in lecture

TABLE 2.—*Approximate equivalent sizes of lettering viewed from various distances*
[Blank spaces indicate nonlegibility]

Size (Points at 18 inches)	Letter Height in inches	Equivalent size in points at distance from observer in feet									
		10	20	30	40	50	60	70	80	90	100
3–16											
18	.25	3									
24	.33	3									
30	.41	4–5									
36	.50	5	3								
42	.58	6	3								
48	.66	7	4								
54	.75	8	4–5	3							
60	.83	9	4–5	3							
72	1.00	10	5	4	3						
84	1.16	12	6	4–5	3						
96	1.33	14	7	4–5	3–4	3					
108	1.50	16	8	5	4	3					
120	1.66	18	9	6	4–5	3–4	3				
132	1.83	20	10	7	5	4	3–4				
144	2.00	22	11	8	5–6	4–5	4	3			
180	2.50	28	14	9	7	5–6	4–5	4	3		
216	3.00	32	16	10	8	6	5–6	5	4	3–4	3

halls. Probably one of the greatest criticisms of the programs at professional meetings is the inability of the audience to read the lettering on maps, charts, and graphs. The problem in all its aspects becomes quite complicated, but the raw data concerning map size and results consequent upon magnification are helpful. It should be practicable in most cases to ascertain the actual size of a projected slide frame as well as the size of the lecture hall. With such information and Tables 3 through 9 most lens and projector characteristics may be ignored.

Tables 3 through 9 give equivalent lettering values for projected maps which are magnified from 2 to 15 times their original size and viewed at various distances from the screen.[4] An example will illustrate their use. Assume a map were being prepared which measured 1 foot across and is to be projected in an auditorium

[4] For magnifications intermediate to those for which the tables are prepared, the data may be adduced for all practical purposes by a linear interpolation.

70 feet long; and further, that the slide frame using the projector equipment is 9 feet across on the screen. From Table 7 (Linear magnification—9) the following information is adduced:

(*a*) The smallest lettering size which can be used on the original that can be read from anywhere in the lecture hall is 16 point.

(*b*) Only the front half of the audience will be able to read 10-point type used on the original.

(*c*) Lettering to be read only by the lecturer at the front as an aid in his presentation should be no larger than 6 point on the original.

It seems wise to re-emphasize the fact that the results obtained by using the tables here presented are subject to some unavoidable error, for many other controls, in addition to size, establish relative or specific legibility. For example, if any lettering is to be on a colored background its legibility and visibility will be reduced (except if the background be yellow) roughly in proportion to the loss of contrast. Differences in styles of type and especially the background patterns of shading or map data may promote or retard legibility. The photographic quality of slides, the lens quality, and the amount of light from projectors frequently vary. Familiar word forms may make undersize lettering recognizable. The tables of equivalent sizes, however, have been calculated solely on the basis of angle subtended at the eye, and do not take into account any of the less significant factors. Equivalent sizes are expressed to the nearest point in the smaller ranges with some clear intermediates noted, while in the larger they are approximate to the nearest even or common type size. Consequently, if any doubt arises as to the effect of any negative factors present, lettering sizes should be increased. Results obtained by following such a rule of thumb will rarely be unsatisfactory.

TABLE 3.—*Linear magnification*—2

[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6										
8										
10										
12	3									
14	4									
16	4–5									
18	5									
24	7	4								
30	9	4–5	3							
36	10	5	4							

TABLE 4.—*Linear magnification*—3
[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6										
8	3									
10	4–5									
12	5									
14	6	3								
16	7	4								
18	8	4–5								
24	10	5	4							
30	12	6	4–5	3–4						
36	16	8	5	4	3					

TABLE 5.—*Linear magnification*—4
[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6	3									
8	4–5									
10	6	3								
12	7	4								
14	8	4–5								
16	9	4–5	3							
18	10	5	4							
24	14	7	4–5	3–4						
30	18	9	6	4–5	3–4	3				
36	22	11	8	5–6	4–5	4	3			

TABLE 6.—*Linear magnification*—6

[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6	5									
8	7	4								
10	9	4–5	3							
12	10	5	4							
14	12	6	4–5	3						
16	14	7	4–5	3–4						
18	16	8	5	4	3					
24	22	11	8	5–6	4–5	4	3			
30	28	14	9	7	5–6	4–5	4	3		
36	33	16	10	8	6	5–6	5	4	3–4	3

TABLE 7.—*Linear magnification*—9

[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6	8	4–5	3							
8	10	5	4							
10	12	6	4–5	3–4						
12	16	8	5	4	3					
14	18	9	6	5	4	3				
16	22	11	8	5–6	4–5	4	3			
18	24	12	8	6	5	4	3–4	3		
24	32	16	10	8	6	5–6	5	4	3–4	3
30	42	21	14	11	9	7	6	5–6	5	4–5
36	48	24	16	12	10	8	7	6	5–6	5

TABLE 8.—*Linear magnification*—12
[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6	10	5	4							
8	14	7	4–5	3–4						
10	18	9	6	4–5	3–4	3				
12	22	11	8	5–6	4–5	4	3			
14	24	12	8	6	5	4	3–4	3		
16	30	14	10	8	6	5	4	3–4		
18	32	16	10	8	6	5–6	5	4	3–4	3
24	42	21	14	11	9	7	6	5–6	5	4–5
30	54	27	18	14	12	9	8	7	6	5–6
36	68	34	24	16	13	11	9	8	7	6

TABLE 9.—*Linear magnification*—15
[Blank spaces indicate nonlegibility]

Point size on original	Approximate equivalent size in points viewed at distance (feet) from screen									
	10	20	30	40	50	60	70	80	90	100
6	13	6–7	4–5	3						
8	18	9	6	4–5	3–4	3				
10	24	12	8	6	5	4	3			
12	28	14	9	7	5–6	4–5	4	3		
14	32	16	10	8	6	5	4–5	4	3–4	3
16	36	18	12	9	8	6	5	4–5	4	3–4
18	42	21	14	11	9	7	6	5–6	5	4–5
24	54	27	18	14	12	9	8	7	6	5–6
30	68	34	23	17	13	12	10	9	8	7
36	80	40	27	20	16	14	12	10	9	8

A Standardized Point for Precision Plumb Bobs

By GEORGE GREENEWALD, JR.,[1] W. A. PARKER.[2] HARRY RUBEY,[3] LEW SUVERKROP,[4] R. E. WHITE[5]

FOR the very first time, a *number* of manufacturers and distributors[6] of precision plumb bobs have gotten together on a *single* design of replacement point. During the past 3 years thousands of these points have served in all kinds of actual field use without a single report of breakage. This confirms extensive tests indicating that the design is suitable for every service requirement. Now being developed in cooperation with the National Bureau of Standards, it is expected to establish a voluntary standard benefiting all manufacturers and distributors as well as users of precision bobs. The importance of this development is better understood when one stops to consider the extensive use of these bobs. Although designed for surveyors, many of them are also used by construction men, carpenters, and all kinds of mechanics, requiring an annual production totalling tens of thousands of complete bobs, with an additional quantity of replacement points.

The most important part of the bob is the point. It takes the brunt of wear and tear in protecting the brass body of the bob to which it is attached by its threaded stem. The point is first an index or pointer. But usually it serves also as a punch or scribe for marking locations in abrasive and hard material such as concrete. In normal use, points are worn out, damaged, broken, and sometimes lost. They frequently require replacement, although users not infrequently have had to continue using them far beyond the meaning of the word "point."

Replacement has been a far more serious problem than is indicated by the small size and moderate cost of a plumb bob point—when and where obtainable. This is partly due to faults of design, material, or workmanship. But to a greater extent it is due to the considerable number of different threaded stems in use. Dealers in hardware and surveying supplies generally have felt they could not afford to stock all the kinds required, and usually stocked none. This has been of no benefit to manufacturer or distributor, and has been a considerable disservice to users. Clearly, if requirements of all makes of bobs were met by a single design of point, this condition would be largely corrected.

Most users, many distributors, and a surprising number of manufacturers realize that plumb bob point design is no such matter of opinion as their past variety seems to indicate. It became apparent some years ago that it should be possible to engineer some design that would recommend itself for acceptance by all manufacturers and users. Naturally, such a design must first be as well or better

[1] General manager, Surveyors Service Co., Los Angeles, Calif.

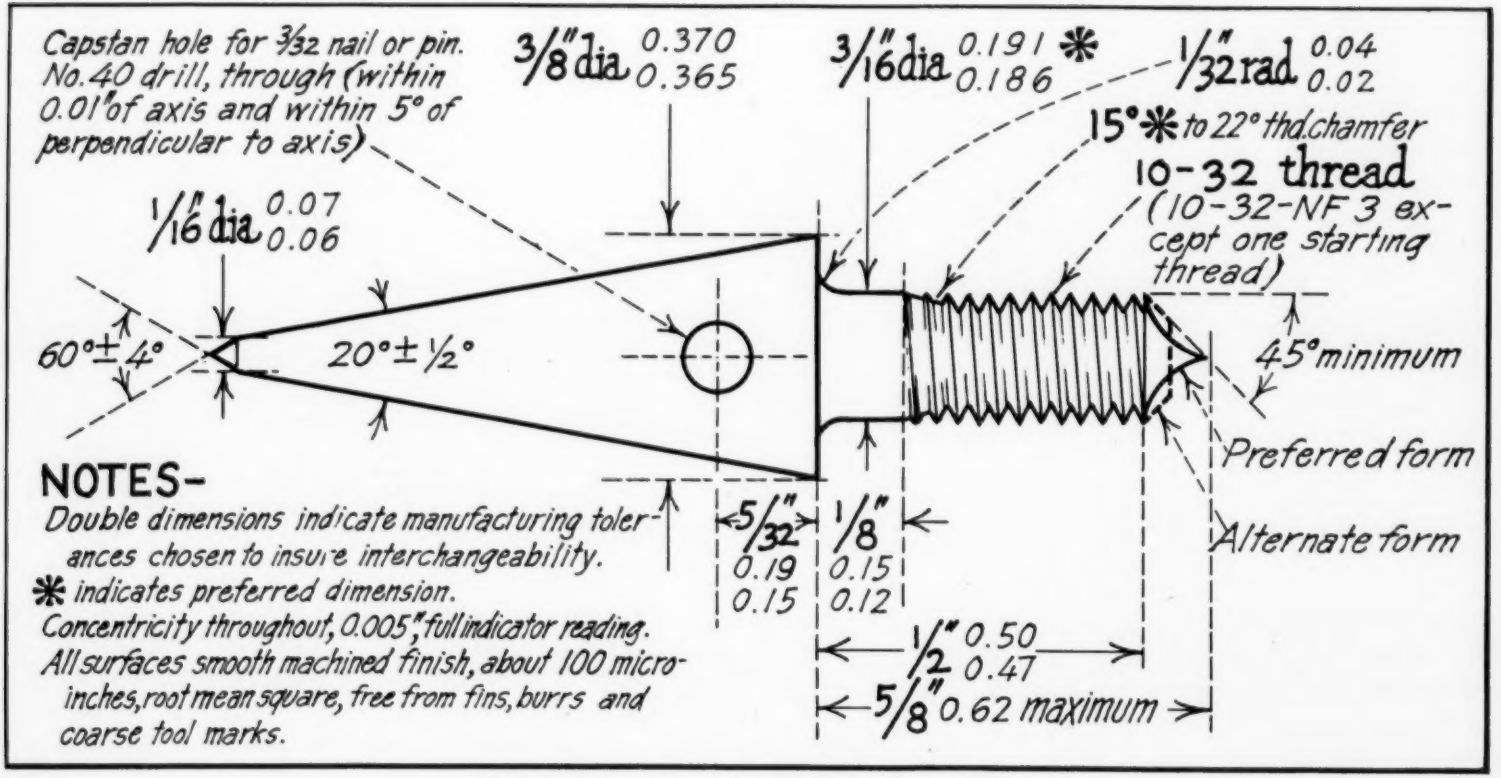
[2] Engineer, Heller & Brightly, Inc., Philadelphia, Pa.

[3] Chairman, department of civil engineering, University of Missouri.

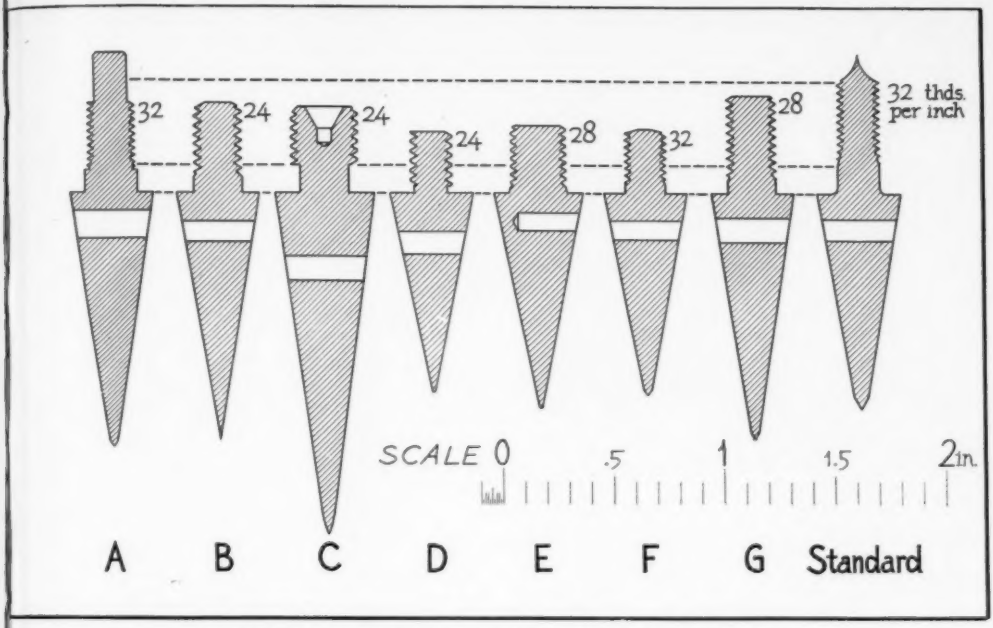
[4] Consulting engineer and land surveyor; engineer, Suverkrop Instruments, Bakersfield, Calif.

[5] Consulting engineer; registered civil engineer, California.

[6] Partial list: C. L. Berger & Sons Co.; Chas. Bruning Co., Inc.; Brunson Instrument Co., Inc.; Heller & Brightly, Inc.; Leupold & Stevens Instruments; The A. Lietz Co.; The Frederick Post Co., Inc.; Surveyors Service Co.; Surveying Instrument Co.; Suverkrop Instruments; and Warren Knight Company.


Capstan hole for 3/32 nail or pin. No.40 drill, through (within 0.01" of axis and within 5° of perpendicular to axis)
3/8" dia 0.370 0.365
3/16 dia 0.191 * 0.186
1/32 rad 0.04 0.02
15° * to 22° thd. chamfer
10-32 thread
(10-32-NF 3 except one starting thread)
1/16" dia 0.07 0.06
60° ± 4°
20° ± 1/2°
45° minimum
Preferred form
Alternate form
NOTES-
Double dimensions indicate manufacturing tolerances chosen to insure interchangeability.
* indicates preferred dimension.
Concentricity throughout, 0.005", full indicator reading.
All surfaces smooth machined finish, about 100 micro-inches, root mean square, free from fins, burrs and coarse tool marks.
5/32" 0.19 0.15
1/8" 0.15 0.12
1/2" 0.50 0.47
5/8" 0.62 maximum

STANDARDIZED POINT FOR PRECISION PLUMB BOB



PROPORTIONS OF SOME COMMON PLUMB BOB POINTS

THE SYMBOLS BELOW THE CROSS SECTIONS CORRESPOND TO THOSE OF THE TABLE BELOW WHICH GIVES DIMENSIONS. ALL DETAILS, INCLUDING THREADS, ARE TO SCALE FROM MEASUREMENTS OF SAMPLE POINTS PURCHASED ON THE OPEN MARKET.

Summary of Nominal Dimensions of Some Common Plumb Bob Points, 1949

Symbol — Except in the case of the "Standard", each point is made by only one mfr.	Approx. RELATIVE NUMBER in use	Nominal BODY DIA.	Dia & thds. per in. of THREADED STEM (i.e. 10-180; ½-12; ¼-24)	EFFECTIVE LENGTH OF STEM.	LENGTH OF NECK (unthreaded part of stem)	KIND of TIP	CAPSTAN HOLE (size and distance from shoulder)	ANGLE of CONE	Remarks
A	13	3/8	12-32	0.40	0.10	0.04 dia., 80° cone	0.102 - 0.14	18° 00′	Unthreaded neck about 0.02 in larger than major dia. of thread. Sharp corners at both ends of unthreaded neck. Cylindrical projection on end. (Patented.)
B	12	3/8	12-24	0.40	0.07	Extremely sharp	0.082 - 0.16	19° 30′	Sharp corner in shoulder. Abrupt thread termination.
C	1	29/64	19/64-24	0.39	None	Curved but sharp	0.102 - 0.33	16° 05′	Extremely abrupt thread termination. Neck undercut, with two sharp corners.
D	4	3/8	10-24	0.27	None	Sharp	0.096 - 0.22	23° 10′	Extremely abrupt thread termination. Neck notched at shoulder, with sharp corners.
E	9	13/32	1/4-28	0.30	0.03	Sharp	0.082 - 0.12	22° 55′	Neck tapers slightly but has sharp corner at shoulder. Abrupt thread termination. Capstan hole not drilled through.
F	25	3/8	10-32	0.27	0.04	0.04 dia. 90° cone	0.082 - 0.16	22° 00′	Abrupt thread termination. Sharp corner at shoulder.
G	1	3/8	12-28	0.44	0.06	0.04 dia., 60° cone	0.104 - 0.16	18° 10′	Rather abrupt thread termination. Sharp corner at shoulder.
Standard — C. L. Berger & Sons Co. Chas Bruning Co. Brunson Instrument Co. Inc Heller & Brightly, Inc. Leupold & Stevens Insts The A. Lietz Co. The Frederick Post Co., Inc. Surveyors Service Co. Suverkrop Instruments Warren-Knight Co. - etc.	30	3/8	10-32	0.50	0.12	0.07 dia., 60° cone	0.098 - 0.16	20° 00′	Shoulder has 1/32 in. radius fillet. Gradual thd. chamfer.

suited to its purposes, compared with any other. It must also be in accord with good and economical manufacturing processes. Finally, the design should minimize conversion costs for manufacturers as a group and as individuals.

In the present paper, directed to users rather than makers of plumb bobs, it is unnecessary more than to mention the manufacturer's problem. The elements of this problem have been given detailed consideration in an earlier paper by the authors, already distributed among all manufacturers as well as most distributors and representative users of precision plumb bobs. Interesting to users is the conclusion of that detailed consideration, that apparently any manufacturer's conversion costs will be both a moderate and a promptly diminishing quantity; and, even for those who have borne the greater expense of pioneering the standard, it will not take long for the cost to be far out-weighed by the advantages accruing from standardization.

Service requirements call for certain characteristics in plumb bob points. First, the elements of the point must be concentric, the axis must be straight, and the threaded connection must hold the point concentric with the body of the bob. Second, the point must be easily attached to or removed from the bob, without any special tool. Third, normal making-up of the threaded connection, accomplished with a nail or capstan pin applied by hand, should cause the point to remain securely in place. Fourth, the point should be hard enough to resist wear and "dubbing" of the tip, and at the same time stout and tough enough to resist breaking, especially in the threaded end.

The limiting dimensions of manufacturing tolerances, which guide manufacturers so as to insure interchangeability, were also detailed in the authors' earlier paper mentioned above. Such tolerances are not the concern of the user, to whom this paper is directed, beyond knowing that they really do insure interchangeability. The user is mainly concerned with the stoutness and proportion of design elements, in order to consider how the stated service requirements will be met by the standard. For that reason, the accompanying drawing translates the manufacturing limits into ordinary nominal dimensions, indicated in bold lettering.

In the user's view, the suitability of the standard is largely due to some characteristics rarely if at all found in other points, and to some not found combined in any other point on the market. The stem is longer than on any point in common use. This gives a suitable number of full threads by which the point is drawn firmly into place. A sharp notch is well known as a place where parts frequently break. Threads are sharp notches, and so also is a sharply squared shoulder—the two commonest places of breakage in previous points. In this standard design the shoulder has a generous rounded fillet of 1/32″ radius, the stem is left unthreaded for a distance of 1/8″, and then the thread is gradually developed as indicated in the drawing. This unthreaded part of the stem fits a counterbore in the body so as to resist lateral forces and save the body threads from damage, and the threads are reserved for their proper function of holding the point securely shouldered and seated. These details result in simplicity, strength, and serviceability greater than otherwise may obtain even with a stem of considerably larger diameter.

Of all the various threads that have been used, the 10–32 thread had been giving satisfactory service in bobs of four manufacturers, two small ones and two

of the very largest. No other thread was used by more than one maker. None is in such common use in plumb bobs, and therefore users would find no other thread so generally usable for bobs already in service. The 3/8″ body diameter has been used by nearly all manufacturers, in about 90 percent of all points produced. The 3/8″ body with 10–32 stem was chosen for the standard. In addition to evident advantages of suitability and popularity, the thought was that acceptance of the standard by manufacturers generally would be facilitated by this choice. It will call for least change in material size and least retooling by manufacturers as a group.

Other features interesting to users include the 1/16″ diameter, 60° conical tip. This is safer and more durable than an extremely sharp tip, and improves the point in its function as an index. The capstan hole is larger than has sometimes been used, permitting use of a stronger, more readily available nail or pin. The through hole obviates digging hardened mud from a blind hole. The preferred sharp cone-like termination of the stem is convenient for making a quick test of quality by spinning a point lightly pivoted between thumb and forefinger.

The objective is to establish a national standard point that takes into account the reasonable interests of all concerned. In particular, users of precision bobs are cordially invited to submit serious criticism and comment. This may be addressed to Lew Suverkrop, Box 436, Bakersfield, Calif., who has been acting as secretary and will transmit it to others concerned with this development. He has a few copies available of the detailed paper mentioned above. Copies of the Proposed Commercial Standard for Plumb Bob Points, which contains general provisions as well as the proposed design, will be sent on request addressed to the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

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Activities of the "Garls"

A recent communication from Comdr. Charles M. Thomas, Chairman of the Public Relations and Publicity Committee of the Georgia Association of Registered Land Surveyors, advises of considerable activity in that organization during the last month of 1949.

On December 3rd, a business meeting of the Officers, Directors and Committee Chairmen was held at the State capital. One of the principal subjects of discussion was the matter of increasing the scope and usefulness of their excellent little official publication, "The Professional Surveyor."

On the 9th, the Fifth District Chapter held a dinner meeting which included routine business and the installation of the new officers, J. R. Bracewell, *President*, and Harold L. Bush, *Secretary-Treasurer*.

The Sixth District Chapter held its meeting in Macon on the next day, followed by a luncheon get-together. Mr. H. L. McSwain, their energetic President, had arranged a most interesting program which included a number of prominent speakers.

The Stade of the Ancient Greeks

By JACOB SKOP

CHIEF, MAP DESIGN, ARMY MAP SERVICE

THE WORLD itself—perhaps appropriately—is the only monument to the unknown Greek who, in the 5th or 4th century B.C., proposed that the Earth was a sphere rather than a flat disc. Except with a few fellow Greeks of perception and equal imagination, the revolutionary hypothesis encountered only derision and ridicule. It wasn't until the middle of the 4th century B.C. that Greek scientists bowed to the logical arguments of Aristotle (384–322 B.C.)[1] and accepted the doctrine of sphericity.

Curiously, even with general acceptance of the theory, the Greeks at first apparently evidenced little interest in the size of the Earth. An unknown contemporary of Aristotle estimated the circumference of the Earth as 400,000 stades.[2] Cleomedes (? 1st century B.C.) mentions a later estimate of 300,000 stades, again by an unknown.[3] No other figures are recorded until about 200 B.C. It was then that the first attempt was made to measure the Earth by methods which with a liberal stretching of the imagination might be called scientific. This was the famous measurement by Eratosthenes (c. 276–195 B.C.)[4] of the arc of the meridian between Syene and Alexandria, from which he computed the circumference of the Earth as 252,000 stades.[5] This was followed, about the beginning of the 1st century B.C., with the measurement by Posidonius (c. 130–50 B.C.) of the arc of the meridian between Alexandria and Rhodes, from which he computed the Earth's circumference as 240,000 stadia.[6] Another hundred years later—about the start of the Christian Era—an unknown Greek essayed to apply corrections to Posidonius' measurements and suggested that the Earth's correct circumference was 180,000 stades. This was the figure accepted by Ptolemy (fl. 127–141 A.D.) and on which he based the data contained in his *Almagest* and *Geographia*.

It has been a fond pastime of cartographers and geodesists of the past 200 years to compare the ancient Greek measurements with those of their own times. But, the comparisons are very confusing since there is no agreement as to what is the correct modern equivalent of the Greek stade.

At first glance, the determination of the true metric equivalent of the Greek stade seems an impossible affair. This is not due to any lack of information as authorities have been overly generous in supplying equivalents. It is this very profusion that creates the initial confusion.

For a basis of decision, numerous sources were studied, the most authoritative being: Captain S. M. Likoudis, R. N., in *Megali Elleniki Engiklopaidhia*, Athens, 1934, Volume 22, p. 266; Gustav Karsten, *Allgemeine Encyclopädie der Physik*, Volume I, *Einleitung in der Physik*, Leipzig, 1869, p. 433; F. U. Brockhaus, *Der Grosse Brockhaus*, Leipzig, 1934, Volume 18, p. 29; and K. Yeroyiannis in *Megali Elliniki Engiklopaidhia*, Athens, 1934, Volume 17, pp. 106–107. Karsten lists his data with a minimum of comment and credits Rome de l'Isle and Jomard as his sources. Likoudis engages in a detailed discussion which is not completely scientific and contains a number of erroneous statements. Likoudis doesn't cite all his sources; however, several of his values are so similar to those

of Karsten that it is apparent that either or both Rome de l'Isle and Jomard were consulted. No sources are cited by Brockhaus who merely lists his data. Yeroyiannis engages in a comprehensive discussion and cites numerous authorities, principally: A. Boeckh, *Metrologische Untersuchungen über des Alterthums*, 1938; Fr. Hultsch, *Griech. und romische Metrologie*, 1882; B. Black, *Massen und Messen*, 1913; G. Viederband, *Forschungen zur Metrologie d. Alterthums Abh. Sachs*, 1917; R. Meissner, *Babylonien und Assyrich*, 1920, Volume I, p. 357; Petrie, *Ancient Weights and Measures, 1926.*

Likoudis lists the following stades:

Stade of Aristotle	100. meters
Stade of Cleomedes and Archimedes	133. meters
Stade of Eratosthenes	159. meters
Stade of Posidonius	167. meters
Stade of Ptolemy	222.22 meters
Olympic stade (based on the metope of the Parthenon)	185.15 meters
Olympic stade (based on the lighthouse of Pharos at Alexandria)	186. meters

Karsten lists the following stades:

Stade of Aristotle, Herodotus and Nearchus; also the small Egyptian stade	99.75 meters
Stade of Cleomedes, Archimedes and Herodotus; also the Persian stade	133. meters
Stade of Eratosthenes and Hipparchus	158.33 meters
Stade of Posidonius	166.25 meters
Stade of Ptolemy; also the Ghaluah of the Arabs	222. meters
Philetarian or Royal stade	
according to de l'Isle	210.14 meters
according to Jomard	224.4 meters
Babylonian, Persian, Chaldean, Hebrew, Delphic or Pythian stade	147.75 meters
Olympic or Roman stade; also the Egyptian stade	184.72 meters

Brockhaus lists the following stades:

Ancient Greek stade	160 meters
Aegina-Attica stade	164 meters
Olympic stade	192 meters
Greco-Roman stade	185 meters

Yeroyiannis lists the following stades:

Attica stade	184.98 meters
Olympic stade	192.27 meters
Walking stade	157.5 meters
Philetarian stade	212. meters

The so-called classical stades—those of Aristotle, Cleomedes, Eratosthenes, Posidonius and Ptolemy—never existed. After a close study, the author is convinced that they had their origin in the mathematical gymnastics of theorists of the 18th or 19th century. They were unquestionably determined by dividing the actual size of the Earth expressed in meters by each of the classical estimates of the Earth expressed in stades. The theorists used a round 40,000,000 meters as the Earth's size. The metric equivalents of the classical stades listed by Karsten are generally slightly smaller than those listed by Likoudis. These differences

are puzzling since they are too great to be attributed to the slight difference in length between the German legal and French meters.

The circumference of the Earth noted by Aristotle was 400,000 stades; dividing this into 40,000,000 meters gives an equivalent of 100 meters to the so-called stade of Aristotle (Likoudis: 100 m.; Karsten: 99.75 m.). The estimate of the Earth noted by Cleomedes was 300,000 stades; dividing this into 40,000,000 meters gives an equivalent of 133.33 meters to the so-called stade of Cleomedes (Likoudis: 133 m.; Karsten: 133 m.). Eratosthenes computed the Earth's circumference as 252,000 stades; this divided into 40,000,000 meters gives an equivalent of 158.73 meters to the so-called stade of Eratosthenes (Likoudis: 159 m.; Karsten: 158.33 m.). Posidonius computed the Earth's circumference as 240,000 stades; this divided into 40,000,000 meters gives an equivalent of 166.67 meters to the so-called stade of Posidonius (Likoudis; 167 m.; Karsten 166.25 m.). The measurement of the Earth used by Ptolemy was 180,000 stades; this divided into 40,000,000 meters gives an equivalent of 222.22 meters to the so-called stade of Ptolemy (Likoudis: 222.22 m.; Karsten: 222 m.).

In examining the stades listed by Brockhaus it is immediately evident that the so-called stade of Ancient Greece is the same as the stade of Eratosthenes. The discrepancy between Brockhaus' figure (160 m.) and those listed by Likoudis (159 m.) and Karsten (158.33 m.) is readily explained. Classical writers have given both 252,000 stades and 250,000 stades as the circumference of the Earth as computed by Erathosthenes (see reference 5). The metric equivalents of this stade as listed by Likoudis and Karsten were based on the 252,000 figure, whereas that listed by Brockhaus was based on the 250,000 figure. This is apparent in dividing 40,000,000 meters by 250,000 stades; the result is 160 meters, the exact figure listed by Brockhaus. The Aegina-Attica stade of 164 meters listed by Brockhaus defies absolute identification. However, its value is close enough to the stade of Posidonius (166.67 meters) to consider assumption that it may be the same.

It is obvious, then, that the classical stades never existed as ground measurements and were entirely manufactured. Outside of serving as verifications of the various classical estimates of the Earth's size, they have no value.

The table of Greek linear measurements preserved by Herodotus has aided materially in the determination of the metric equivalent of the stade; a modernized version of the table—expanded by the author—appears at the end of this article.

The Greek stade as a unit of linear measurement had its origin in the length of the foot-course of the Olympic games; this was 100 double paces. The early games were held in a natural arena on the side of a hill at Olympia in Elis; here the length of the course was paced off and varied somewhat from Olympiad to Olympiad. Later—especially from the time that the athletes competed in enclosed arenas—the length of the course became standard. This was accepted as the official length of the stade and was generally identified as the Olympic stade.

The correct metric equivalent of the Olympic stade is determined from measurements of the *metope* (the larger room) of the Parthenon and of the base of the lighthouse of Pharos in Alexandria.

The Parthenon was built by Phinias in 447 B.C. to replace a former wooden structure destroyed by fire. It is known that the *metope* was laid out as exactly

100 *podhes* (1 *plethron*).[7] The *metope* was measured in the 18th century as noted by David le Roy.[8] Foucherot, a French engineer, found the length of the *metope* to be 95 French feet (old unit of measure). Since the French foot equalled 0.324839 meter, the length of the *metope* equals 30.8597 meters. Thus, one stade (6 *plethra* equal 1 stade) based on the Parthenon equals 185.1582 meters (30.8597×6).

The lighthouse of Pharos in Alexandria was erected about 283 B.C. The length of each side of its square base is known to have been also 100 *podhes* (1 *plethron*).[9] Engineers of Napoleon's army measured this as exactly 31 meters. Thus, one stade according to the measurements of the Pharos lighthouse equals 186 meters (31×6).

This results in two slightly different equivalents for the Olympic stade—that of 185.1582 meters—presumably in use prior to about the 3rd century B.C.—and that of 186 meters—presumably used during and after the 3rd century B.C. There is a possibility that the stade never varied and that either the *metope* of the Parthenon or the base of the lighthouse of Pharos was not exactly 100 *podhes* in length as indicated in the literature describing these two ancient wonders of the world. But, in the absence of any data to the contrary, we are forced to accept the two different values as being correct.

Karsten lists 184.72 meters as the value of the Olympic stade. (Jordan-Eggert, *Handbuch der Vermessungskunde*, Volume III, 1st Half-volume, Stuttgart, 1939, p. 2., used the value of 185 meters, incorrectly citing Karsten as authority.) Karsten's short value probably results from the fact that the metric equivalent for the old French foot was not carried out sufficiently beyond the decimal point and accepted as about 0.324 meter.

Yeroyiannis lists an Attica stade of 184.98 meters. This is the Olympic stade under an alias; and, just as with Karsten, the use of an abbreviated equivalent for the French foot probably caused the slight shortage.

Brockhaus lists a Greco-Roman stade of 185 meters. This again is the Olympic stade under an alias, rounded off to the nearest meter. Brockhaus lists an Olympic stade of 192 meters; Yeroyiannis also lists this but with a value of 192.27 meters. Possibly, a stade of such a value did exist; more probably, it resulted from an inaccurate conversion made by some mathematical acrobat of an earlier century.

The Babylonian stade of 147.75 meters is listed by Karsten as having been used by the Babylonians, Chaldeans, Persians and Hebrews. Perhaps this, too, is an imaginary stade based on an estimate of the Earth's circumference. On the other hand, D'Anville[10] in describing Alexander's marches through Asia refers to an Asiatic stade which was shorter than the Olympic stade. There is a possibility that this is it. However, no further research is required since whether or not such a stade actually existed has no bearing on the present discussion—the determination of the metric equivalent of the Greek stade.

Yeroyiannis lists a *walking* stade of 157.5 meters. The exact equivalent should not be accepted unquestionably since this stade consisted of 100 double paces taken in stride. It was used to approximate distances and from its nature could not have been accepted as the basis for computing scientific measurements. More than likely, this was the small stade mentioned by D'Anville which was used by Alexander in estimating the lengths of his marches through Asia Minor.

Finally, the Philetarian or Royal stade listed by both Karsten and Yeroyiannis remains for consideration. This stade consisted of 600 Philetarian or Royal feet and was used in Asia Minor. Rome de l'Isle gives an equivalent of 210.14 meters; Yeroyiannis lists an equivalent of 212 meters. Jomard disagreed with de l'Isle and gave the equivalent of this stade as 224.4 meters, but incorrectly regarded it as the same as the imaginary classical stade of Ptolemy (222.22 meters). Considering that its origin is oriental, it is very doubtful that this stade was used by the classical Greeks in estimating the Earth's size.

The table of Greek linear measurements which appears below is based on J. Tallboys Wheeler, *The Geography of Herodotus*, London, 1854, Appendix II and Yeroyiannis, *Megali Elliniki Engiklopaidhia*, Athens, 1934, Volume 17, pp. 106–107. The metric equivalents were computed by the author and are based on the Olympic stade of 185.1582 meters (figured on the *metope* of the Parthenon) and the Olympic stade of 186 meters (figured on the lighthouse of Pharos in Alexandria).

Table of Greek Linear Measurements

		Parthenon value	Pharos value
1 dhaktilos (digit)	equalled 1 finger's breadth	.0193 m.	.0194 m.
4 dhaktiloi	equalled 1 palaistai (palm)	.0772 m.	.0775 m.
3 palaistai	equalled 1 spithami (span)	.2315 m.	.2325 m.
4 palaistai	equalled 1 pous (foot)	.3086 m.	.31 m.
2 spithamai (1.5 podhes)	equalled 1 pikhis (cubit)	.4629 m.	.465 m.
4 pikhis (6 podhes)	equalled 1 orgyia (fathom)	1.8516 m.	1.86 m.
16 ⅔ orgyiai (100 podhes)	equalled 1 plethron	30.8597 m.	31. m.
6 plethra	equalled 1 stade	185.1582 m.	186. m.

The Persian *parasang* was equal to 30 *walking* stades (157.5 meters) or 4,725 meters. The Egyptian *schoenus* was equal to 40 *walking* stades or 6,300 meters. Also, there was a system of measurement called Philetarian or Royal; this was used in Asia Minor and was based on the Royal cubit which was larger than the Greek cubit. Yeroyiannis lists 0.525 meters as the equivalent of the Royal cubit.

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1. Aristotle. *De caelo*, Translation of W. K. C. Guthrie. Loeb Classical Library, Harvard University Press, 1939.
2. Aristotle. *De caelo, op. cit.*, p. 255.
3. Cleomedes. *De motu circulari corporum caelestium.* Translation of Hermann Ziegler. Leipzig, 1891. I, 8, p. 79.
4. For a description of the test: Cleomedes, *op. cit.*, I. X; or Thalamas, A. La geographie d'Eratosthene. Versailles, 1921. pp. 128–164.
5. Cleomedes, *op. cit.*, pp. 97–101 gives 250,000 stades. Hero, *Dioptera*, translation of Herman Schöne, Leipzig, 1903, p. 103 and Strabo, *The Geography of Strabo*, translation of Horace Leonard Jones, Loeb Classical Library, G. P. Putnam's Sons, 1917, Volume I, p. 505 both give the figure of 252,000 stades. After considering the sources of each of the cited authors, the author believes the 252,000 stades figure to be the more authoritative.
6. Complete details of the measurements are recorded by Cleomedes, *op. cit.*, pp. 91–95. Erwin Raisz, *General Cartography*, McGraw-Hill, 1938, p. 17 gives 180,000 stades as the measurement of Posidonius. This is probably based on a reference given by Strabo (see Strabo, *op. cit.*, Vol. I, p. 365). Strabo merely notes the figure in

a passing reference to Posidonius' measurement, without any details and is probably referring to the corrected figure of Posidonius.

7. *Megali Elliniki Engiklopaidhia*, Athens, 1934, Volume 19, p. 696.
8. David le Roy, *Ruins, les plus beaux monuments de Grece*, p. 49 and *Precis d'une dissert. sur mesur. des anc.*, p. 9.
9. *Megali Elliniki Engiklopaidhia*, Athens, 1934: Volume 3, p. 576; Volume 22, p. 266.
10. D'Anville, *Recherche geographique golfe Persique* in *Memo. Acad. Inscri.*, Volume 30, p. 132.

Radar Charts for the Great Lakes

Experimental radar charts of the St. Marys River have been prepared by the U. S. Lake Survey and placed aboard radar-equipped Great Lakes vessels of American registry for use and comment. In the preliminary form, the charts consist simply of mosaics of photographs of the radarscope of a commercial ore carrier made during regularly scheduled upbound and downbound passages through the river, overprinted in transparent fluorescent ink on the regular navigation charts, comprised of three 36″ by 48″ sheets drawn to the scale of 1:40,000. In daylight, or under usual forms of artificial light, the charts appear as normal navigation charts but, when subjected to black light in semi-darkness, present a simulation of the radarscope image superimposed on the chart features. Future form and content of radar charts as well as the areas to be covered on the Great Lakes will be based largely upon comments received from users of the experimental series. Regular issue of such charts is at least a year in the future, however.

New Maps of Minnesota—Ontario Lake Region

A new series of maps of the Minnesota-Ontario Border Lakes between Rainy Lake and the headwaters of the Pigeon River is in preparation by the U. S. Lake Survey. The maps are being compiled from existing source material, most prominent of which is that included in the surveys of the International Boundary Commission, the International Joint Commission, the U. S. Forestry Service, and the Province of Ontario, Department of Lands and Forests. Reconnaisance survey of the mapped area will provide additional information of particular interest to the canoeist or boatman. The first edition of the series of maps, expected to be available for distribution in May 1950, will comprise 13 sheets measuring 17″ by 22″, plotted on the Lambert conformal conic projection, depending on North American datum of 1927, to the scale of 1:42,240 (1½″ = 1 mile), and will be printed in colors on wet-strength paper suitable for use under the exposed conditions to be encountered in small open boats.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

A NEW INSTRUMENT FOR DEAD RECKONING. *Rivista Aeronautica,* April 1948. (A universal graphical drawing instrument for measuring angles and distances is described.)

MAPS. *The Library of Congress Quarterly Journal,* August 1948. (Reports on the quantity and quality of cartographic material received in the Library of Congress's Division of Maps.)

RECENT DEVELOPMENTS WITH RESPECT TO THE CONTINENTAL SHELF. Richard Young, *The American Journal of International Law,* October 1948.

MODERN COLLIERY SURVEYING. M. N. Nielsen, *The Australian Surveyor,* September–December 1948.

MAP SYMBOLS USED IN PUBLICATIONS OF THE U. S. GEOLOGICAL SURVEY. *California Journal of Mines and Geology,* January 1949. (Lists map symbols tentatively adopted to portray geologic structure, mineral deposits, and mine workings.)

REPRODUCTION OF THE 1:250 AND 1:2,500 SCALE NATIONAL PLANS OF GREAT BRITAIN. S. G. Hudson, *Empire Survey Review,* January 1949. (Outlines the method of reproducing these plans and the resultant 1:2,500 scale plans of urban areas.)

THE EARLY NAVIGATOR. E. R. Taylor, *The Geographical Journal* (London), January–June 1949. (Describes the history of navigation, and some of the problems encountered, namely: projection of the chart, variation of the compass, and determination of longitude.)

WHERE ANGELS FEAR TO TREAD. A. F. Wightman, *The Canadian Surveyor,* February 2–3, 1949.

TRENDS IN MAPPING. G. G. Tschume, *The Canadian Surveyor,* February 2–3, 1949.

EUROPEAN FIRST-ORDER TRIANGULATION AND ITS ADJUSTMENT. Floyd W. Hough, *Photogrammetric Engineering,* March 1949.

A GEODETIC MEASUREMENT OF UNUSUALLY HIGH ACCURACY. C. L. Garner, *The Journal, Coast and Geodetic Survey,* April 1949.

THE ORTHOMORPHISM OF THE STEREOGRAPHIC PROJECTION. Norman Pye, *Empire Survey Review,* April 1949. (Discusses the stereographic solution of the spherical triangle and its application to field astronomy.)

STATE GEOLOGICAL SURVEYS. *California Journal of Mines and Geology,* April 1949. (Gives an account of the activities of each state geological survey.)

AERIAL SURVEY OF SOUTHEASTERN ALASKA 1948. Thomas F. Pollock, *Photogrammetric Engineering,* June 1949. (Describes the aerial survey of Southeastern

Alaska, made by the Navy, which resulted in the successful photographic coverage of all of the Alaska "Panhandle"—an area of 45,000 square miles.)

KEEPING TRACK OF THE EARTH'S MAGNETIC FIELD. L. R. Alldredge, *Research Reviews,* June 1949. (Reviews briefly the early knowledge of earth magnetism, and describes the characteristics of the earth's magnetic field. Improvements on instruments are outlined and a comparison made of survey methods by non-magnetic ships and proposed airborne techniques.)

NEW LIGHTING FOR HIGH-SPEED PHOTOGRAPHY. W. R. Plant, *General Electric Review,* June 1949. (A new photolight is described which makes possible the recording of phenomena occurring at speeds beyond the scope of ordinary photographic technique.)

WRITING TECHNICAL REPORTS. K. A. Kobe, *Journal of Engineering Education,* June 1949. (Points out that colleges and industry have failed in giving the student or employee proper instructions as to how a good technical report should be written.)

DIAL GAGE METER BAR AIDS PRECISION IN MAP MAKING. Milton A. Stovall, *Engineering News-Record,* July 14, 1949. (Describes a meter bar capable of accuracy to two one-thousandths of a millimeter.)

PORTABLE REFLECTING PROJECTOR SIMPLIFIES MAP MAKING FROM PHOTOS. Daniel E. Houghton, *Engineering News-Record,* July 21, 1949. (Describes the development of a projector which, by mechanical means, makes possible a rigorous mathematical solution of the problem of continuously sharp focusing.)

BOOKS AND PAMPHLETS

THE THEORY OF MAP PROJECTIONS. D. R. Hendrikz, *Government Printer,* Pretoria, South Africa. 1948. 127 pages. 10s. net. (Deals with the geometry of curves and surfaces, the representation of the spheroid on the plane, and the conformal representation of the spheroid on the sphere.)

HISTORICAL GEOGRAPHY OF THE UNITED STATES. Ralph H. Brown. *Harcourt, Brace and Co.,* New York. 1948. 596 pages. (Deals with the development of our country.)

PROCEEDINGS OF THE FIRST SURVEYING AND MAPPING CONFERENCE, OCTOBER 22–23, 1948 (Bulletin No. 24). *University of Florida,* Gainesville.

THE REGIONAL ATLAS. John Bartholomew (Introduction by Prof. A. G. Ogilvie). *Geographical Institute,* Edinburgh. 1948. 45s. (Contains 160 sheets mostly drawn on scales which are multiples of one to one million.)

A SYSTEMATIC REGIONAL GEOGRAPHY. A World Survey from the Human Aspect. Volume III. J. F. Unstead. *The University Press,* London. 1948. 15s. (This book is designed as a summary of the human aspects of geography. It is generously illustrated with diagrams and maps.)

SYMBOLS FOR LARGE SCALE MAPS (AMS Technical Manual No. 13). *U. S. Army Map Service,* Washington, D. C. 1948. 79 pages.

CHAMBER'S SIX-FIGURE MATHEMATICAL TABLES. Volume I—Logarithmic Values. Volume II—Natural Values. L. J. Comrie. *W. & R. Chambers, Ltd.,* Edinburgh and London. 1948–49. 42s. (Contains six-figure tables which include tables giving values of certain functions, such as the hyperbolic functions.)

—A. A. Stanley

DISTINCTIVE RECENT MAPS

The war years witnessed a remarkable shift in population within the United States. The result of this migration is graphically illustrated on Rand McNally & Company's new map *Population Shifts in the United States, 1940–1948.* Gains of *50 percent and over, 25 to 50 percent,* and *less than 25 percent,* and "loss or no change," are indicated for counties by varying color intensities. Data is "based on 1948 county population estimates developed by Rand McNally & Company." The major areas showing notable population gains in the period represented are in the far West, including the States of Washington, Oregon, California, Nevada, and Arizona. Appreciable increases are also indicated in southern New England, the middle Atlantic region, western New York State, the Middle West, and the Gulf Coast area. The map is at the scale 1:7,500,000 and measures 17¼ × 25 inches.

Municipalities of the New York Metropolitan Region is the title of a new map prepared (in 1949) by the Regional Plan Association, Inc., New York City. It shows, in black and white, state, county, township, and municipality boundaries. A "List of Municipalities by States," at the bottom of the map, identifies cities, boroughs, towns, townships, and villages. The map measures 24 × 30 inches and is at the scale of 1 inch to 5 miles.

Mapa Pluviométrico de Españo y Portugal is the title of a rainfall map of the Iberian Peninsula, recently acquired by the Library of Congress. It was published in 1942 by the Seccion de Tecnica General, [Spanish] Ministerio de Obràs Públicàs. The map is at the scale of 1:1,000,000 and is printed on two sheets, each measuring 39 × 26½ inches. Isohyets and color gradations show mean annual rainfall distribution. The map also shows relief by contour lines, with an interval of 200 meters. The publisher is I. G. Seix y Barral Hnos. S.A., Barcelona.

Japan Land Use is the title of a new map which should be of especial interest to Geographers. It is at the scale of 1:800,000 and is printed on three sheets, each measuring around 38 × 28 inches. The map was "prepared by the Geographical Survey Bureau, Ministry of Home Affairs, Japanese Government, in compliance with directions by General Headquarters, Supreme Commander for the Allied Powers, and technical instructions from the National Resources Section." Land use and other features are based on the 1:50,000 topographic sheets of the Geographical Survey Bureau. *Japan Land Use* was published at Chiba, Japan, in July 1947.

Color and symbol designations differentiate paddy fields (single and double-cropped), upland fields, mulberry, tea, fruit orchards, pasture, forest areas, wastelands, marsh land, and salt beds. Various classes of railroads and highways as well as urban counties, harbors, mines, quarries, and oil fields are also shown. Faint contour lines, with an interval of 200 meters, portray the physical character of the land.

The Geological Survey of Canada (Mines and Resources Branch, [Canadian] Department of Mines and Resources) published in 1949 a new Geological *Map of the Maritime Provinces* on the scale 1:760,320. The map is designed to show on a comprehensive scale the available information on the geology of the three maritime provinces (New Brunswick, Nova Scotia, and Prince Edward Island). It adjoins the East and Center Sheets of the map of Southern Quebec, published in 1943. Because the known information for some areas is greater than for others, two different systems of coloring are used. This emphasizes the large amount of geological work still to be done in the area. The map measures 36 by 42½ inches.

Densité de la Population is the title of a new population map of France prepared by the Institut National de la Statistique et des Etudes Economiques, and published in 1948 by the Institut Geographique National. The map is based on the Census of 1946, and shows population densities per square kilometer for each canton, by seven color gradations.

The scale of the map is 1: 1,400,000 and the size 27½ by 31 inches. This map is one of a series, covering various data, issued by the I.G.N. at the same scale. Comparison and relationship studies are thus facilitated.

The "geography of Britain's railways at the close of private ownership, December, 1947," is shown on a new *Railway Map of England and Wales and Scotland,* published in 1948 by Ian Allan Ltd., London. Published in atlas form with 39 sectional maps, it is based on the official maps issued by the Railway Clearing House. The scale is 1: 475,000. An index of almost 8,000 names is bound with the maps.

The four principal railroad lines, (Great Western; London, Midland & Scotland; London & Northeastern; and Southern) are distinguished by individual colors. Other lines are indicated by name.

Communication systems of Sweden are shown in detail on a new *Kommunikationskarta över Sverige,* compiled by the Kungl. Generalpoststyrelsen, Kungl. Telegrafstyrelsen and Kungl. Järnvägsstyrelsen. It was published at Stockholm in 1948 by Generalstabens Litografiska Anstalts Förlag. The map is on two sheets each 45 by 34½ inches, and is at the scale 1: 700,000. A 77-page index of place names accompanies the map.

The southern sheet includes enlarged inset maps of Skane, Motala-Linköping, Karlshamn-Karlskrona, Göteborg, Lidköping-Tidaholm, and Stockholm. The Sundsvall-Nyland area appears as an inset on the northern sheet.

Mapa de la Republica de Bolivia is a new official map of that country, dated 1947. The map, which is of the political type, shows administrative divisions: roads, railroads, and urban centers. Generalized relief is indicated by shading. It was planned and executed by Rene R. Comacha Lara, and printed by R. Zumelzu y Cia, La Paz, Bolivia. Below the title is the notation, "Impreso en la Presidencia Constitucional del Excmo. Señor Dr. Enrique Hertzog." A portrait of Dr. Hertzog appears in the upper right corner of the sheet. The map measures 49 by 41 inches and is at the scale of 1: 1,500,000.

During the past three decades free oil company road maps have become an accepted custom for American motorists. Accurate and attractively printed "gas maps" are standard equipment in the glove compartment of virtually every car on the road. It is of interest, therefore, to note that the oil companies are expanding free distribution of road maps to other countries in the Western Hemisphere.

Four such new foreign road maps have recently been prepared for *Esso* by the General Drafting Company of New York City. They include *Quebec Road Map, Maritime Provinces Road Map, Manitoba, Saskatchewan and Western Ontario Road Map,* and *Mapa de la República Oriental del Uruguay.* The cartographic style and lithography are similar to that on *Esso* maps distributed in this country.

The Uruguay map is at the approximate scale of 25 kilometers to an inch, with an enlarged section of the *Playas del Rio de la Plata* at 12 kilometers to an inch. On the verso is a pictorial map of the country and a plan of the central part of Montevideo. Descriptive text is in Spanish.

The Canadian maps show enlarged insets of the environs of the major cities, and are also supplemented by descriptive text. On the Quebec map text is in both English and French.

—Walter W. Ristow

Books in Review

ADVANCED SURVEYING AND MAPPING. George D. Whitmore. *International Textbook Co.*, Scranton, Pa. 1949. 619 pages. $5.00.

Reviewed by HARRY BOUCHARD, Professor of Geodesy and Surveying, University of Michigan.

THIS book by the Chief of Technical Staff, Topographic Division, U. S. Geological Survey, includes the material which appeared earlier as "Elements of Photogrammetry" and "Geodetic Surveying," in 1941 and 1942. Where necessary this material has been revised and brought up to date. Several new chapters have been added covering Control Surveys in Cities, Basic Maps for City Work, Map Compilation Procedures, Map Revision Procedures, and Map Finishing and Reproduction. Abbreviations of the tables used in computing geographic positions and in plotting polyconic projections are included. There is a very complete bibliography and an appendix illustrating the adjustment of a quadrilateral by the direction method when weights are involved.

In his preface Mr. Whitmore states that although it is generally assumed that a knowledge of advanced algebra, spherical trigonometry and calculus is required to understand thoroughly certain phases of geodetic surveying, the book can be studied intelligently by anyone with a good working knowledge of elementary algebra and plane trigonometry. With that in mind he has omitted the derivation of certain formulas and the proof of the correctness of certain procedures that are based on the theory of least squares. He has, however, made reference to where such material, much of it in Coast and Geodetic Survey publications, can be found. The result is a much more compact volume than would have been the case had all such derivations been included.

There are numerous problems at the ends of the chapters, thus adding to its value for classroom use. It is a valuable reference book for the practicing engineer or surveyor who is called upon to make surveys of more than moderate precision.

* * *

Pocket Ephemeris

THE "Keuffel & Esser 1950 Solar Ephemeris," a pocket-sized booklet of 112 pages, which should be extremely useful to surveyors, engineers, and instructors, is now available.

Following a brief discussion of various instruments, there is a chapter devoted to celestial observations in which Prof. Philip Kissam of Princeton University explains his method of computing the hour-angle of Polaris by civil rather than sidereal time. Prof. Kissam also includes explanations and examples for determining true north from any latitude north or south, for the determination of latitude, and for the application of a time observation to obtain longitude or the hour-angle of a circumpolar star.

The user will also find the complete data required for observations on 18 of the best navigational stars, besides Polaris and the sun. This makes reference to other almanacs unnecessary except in special cases.

Complete stadia tables for computing horizontal and vertical components of inclined stadia sights are another new feature.

—HELMUTH BAY

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

THE SPIRIT THAT BUILDS ACSM

I was very much pleased to receive your recent letter and inclusion relative to Mr. Wm. C. Wattles, the new chairman of the Property Surveys Division.

Frankly, I know of nothing that I would rather do than some of the necessary missionary work in this region. For the past 5 years I have made a point of speaking to at least one service club per year, and right now I have several of them booked for talks specifically based on the nature, ethics, and standards of our work. The principal objective, I have found thus far, is to awaken the public to its own responsibilities relative to the ownership and transfer of land tracts, and the true function that our profession should have in this respect.

It will be a sincere source of satisfaction and pleasure to be permitted to be of assistance to Mr. Wattles, and I hope that I hear from him as soon as possible. —GORDON E. AINSWORTH, Whately, Mass., in a letter to S. A. Bauer.

(Mr. Ainsworth was the subject of an article entitled "Country Surveyor" in the October 29, 1949 issue of *The Saturday Evening Post*.—ED.)

FROM A PROSPECTIVE MEMBER

I have always wanted a magazine or publication on surveying, but up to this time I have not found one . . . if you will send me a sample copy of this magazine, it is more than likely that I shall make application for membership in the American Congress on Surveying and Mapping. It is likely that I could be classed as a surveyor, as I have been at that kind of work for 43 years, and I find that there is always something new to be learned about this kind of work.

If you will send me a copy of your magazine, it will be very highly appreciated, and you might send me an application blank for membership.—JOHN BOLDRIDGE, Griffinsburg, Va.

Reply by President Bauer

. . . One of the very satisfactory features connected with my activities with the American Congress on Surveying and Mapping has been the periodic receipt of letters from men such as you, who for the first time learn of the Congress and become our ardent supporters. We need ardent supporters for the reason that, for some time to come, we in the Congress must consider ourselves as missionaries of the gospel of good surveying. This takes men who love their profession, and respect the contribution it makes to our scheme of life; it takes men who are un-

selfish in their willingness to promote their profession, and to educate their fellowmen who may be less inclined in those directions.

WHAT WE LIKE TO HEAR

The information I received from the Congress last year in the Journals answered many questions often that an engineer would like to know.

I am very much interested in Property Surveying, as a large part of my work is in that field, and in Cartography and Surveying Instruments.

Many thanks for the valuable information passed along to us during the last year.—J. H. GRAHAM, London, Ky.

It is hard to understand how anyone in this game can look over the Congress publications and not sign on the dotted line, at once.—D. K. GEMUNDER, Salem, Oregon.

New Swedish Surveying Tripod Permits Centering of Instruments

A NEW TRIPOD permitting combined centering and leveling of surveying instruments equipped with optical plum indicators has been designed under the auspices of the Royal Institute of Technology of Sweden, according to a report released to the American public by the Office of Technical Services of the Department of Commerce. Leveling screws for the instrument are provided in the tripod itself.

In principle, the design varies from conventional types in that the axes of the leveling screws are coincident with the longitudinal axes of the tripod legs instead of being perpendicular to the horizontal circle of the instrument. When the instrument is leveled, it is said to be rotated about a center which is approximately in the center of the plane triangle defined by the three points on the ground where the tripod feet are placed. This will, in general, also be the location of the survey point over which it is desired to set the instrument.

The improvement claimed is that the instrument, when leveled after being set up over the ground point with the aid of its optical plummet, will require only a very slight movement to correct for residual centering error. With conventional types, the optical plummet will not indicate even an approximate centering until the instrument is leveled, thus requiring the use of a supplemental plumb bob or a series of successive approximations in setting up.

It is reported that in a test series of 10 combined centering and leveling positions, the average time required per set-up was determined to be 45 seconds.

A detailed mathematical development of the theory of the new design is included in the report, and also an alignment chart which indicates the magnitude of errors in centering, due to varying tripod heights that are necessary in practical use.

This report, PB 95407 "A Method of Combined Centering and Leveling for Surveying Instruments Equipped with Optical Plumb Indicators," is in English, and consists of 28 pages, with diagrams, graphs, and tables. It sells for $3.75 in photostat form, $2.00 in microfilm. Address orders to the Library of Congress, Photo-duplication Service, Publication Board Project, Washington 25, D. C. Check or money order should be made payable directly to The Librarian of Congress to be acceptable.—*Engineering News-Record*, August 4, 1949.

CONGRESS NEWS

Officers and Committee Chairmen for 1950

The following Officers were appointed by President Bauer, with the approval of the Board of Direction, to serve for the calendar year 1950:

Walter S. Dix, *Executive Secretary*
Richard T. Evans, *Treasurer*
Aaron L. Shalowitz, *Editor-in-Chief*

Committee Chairmen

Kenneth T. Adams, *Finance and Auditing*
Helmuth Bay, *Publications* (Acting)
Frank S. Borden, *Membership*
Murray Y. Poling, *Annual Meeting*
Albert A. Stanley, *Public Relations*

Activities of Topographic Surveying and Mapping Division

The reactivation of the Technical Division on Topographic Surveying and Mapping will contribute considerably to the fulfillment of the primary aim of the Congress—the advancement of mapping. Unquestionably, the reactivation will be welcomed, since topographic surveying and mapping constitutes a large percentage of interest of the members.

The aims of the Division, which are incorporated in the constitution submitted for approval to the Executive Committee of the Congress, are to improve the science of topographic surveying and mapping by the following:

(*a*) Encouraging the development of new techniques and instruments related to topographic surveying and mapping.

(*b*) Fostering a program for the periodic revision of existing standard topographic map series.

(*c*) Reviewing present standards and specifications for surveying and mapping and recommending changes wherever they seem desirable.

(*d*) Fostering a program to evaluate and classify all series of topographic maps.

(*e*) Encouraging and assisting all efforts to obtain appropriation of sufficient funds to carry out an adequate program of surveying and mapping in the several States of the Nation.

(*f*) Disseminating to members of the Congress and to the general public, through appropriate media, details of development in surveying and mapping procedures, techniques, and instruments and equipment.

To implement these aims and to serve until the special election is held for the Division, the organization committee established four committees, with chairmen, as follows:

C. S. Maltby, U. S. Geological Survey, *Program*
S. V. Griffith, U. S. Coast and Geodetic Survey, *Membership*
J. S. McCall, Army Map Service, *Research and Development*
J. E. King, U. S. Forest Service, *Technical Standards*

A temporary Secretary-Treasurer, S. V. Griffith, and a temporary Associate Editor, Jacob Skop of the Army Map Service, have been appointed to serve until these offices are filled from the membership-at-large. The governing body of the Division will consist of a Board of Direction composed of a chairman and six directors each with a 3-year term of office. Since it is desirable for the Board to change partially each year, the term of the directors in the coming election will vary—two each will serve 3 years, 2 years, and 1 year, respectively.

The nominating committee has nominated the following:

Officer
(To serve for 3 years)
C. S. Maltby, U. S. Geological Survey, *Chairman*

Directors
(To serve for 3 years)
J. E. King, U. S. Forest Service
T. W. Noreross, Chevy Chase, Md.

Directors
(To serve for 2 years)
John McCall, Army Map Service
Robert H. Smith, Glendale, Pa.

Directors
(To serve for 1 year)
C. M. Durgin, U. S. Coast and Geodetic Survey
L. H. Woodward, San Antonio, Texas

Congress members who have indicated an interest in the Division are being sent copies of the constitution, a ballot, and a brief biographical sketch of the candidates for office.

Membership in the Division is open to all members of the American Congress on Surveying and Mapping. The Division will meet as part of the coming Annual Meeting of the Congress. Those interested in joining are urged to communicate with the temporary Secretary-Treasurer, S. V. Griffith.

Members and prospective members of the Division who are interested in particular phases of the Division's program are urged to communicate with the temporary chairman of the appropriate committee.

C. S. Maltby,
Chairman

Activities of Control Surveys Division

At a recent election participated in by members of the Technical Division on Control Surveys the following officers and directors were selected:

Floyd W. Hough, Army Map Service, *Chairman* (1950)
R. M. Wilson, U. S. Geological Survey, *Director* (1950)
Carroll F. Merriam, Pennsylvania Water & Power Co., *Director* (1950–51)

Mr. Wilson will be chairman for 1951 succeeding Mr. Hough, and Mr. Merriam will be chairman for 1952 succeeding Mr. Wilson.

The committee on Highway Surveys under Mr. Carpenter has proposed tentative Standards for Highway Surveys which we hope to have distributed rather widely among the highway engineers. Eventually we expect a final draft of the Standards to be adopted, but only after comments from those actually engaged on highway surveys are obtained and studied with reference to any changes which may be desirable.

The Committee on Standards under Mr. Wilson is in an active status and will continue to function. This committee is reviewing Standards for Control Surveys with particular reference to the interests of private and commercial survey practitioners.

I have been chairman of this Division during the past 3 years. The organization of the Division is on a sound basis. I am sure that under Mr. Hough's leadership the Division will continue its influence for better survey practices and will be a potent factor in the growth of the Congress.

—H. W. HEMPLE

Resolutions Committee for Tenth Annual Meeting

A Resolutions Committee for the Tenth Annual Meeting of the American Congress on Surveying and Mapping has been appointed by the president. The committee is headed by Robert Moravetz, U. S. Geological Survey, who is to be assisted by Robert Voskuil, Vienna, Va., and F. G. Williams, of W. & L. E. Gurley.

The membership of the Congress is urged to prepare such resolutions as it may see fit to present before the annual meeting. These resolutions should be presented to the Resolutions Committee as soon as practicable. The Resolutions Committee will meet at the end of the first day of the annual meeting, June 21, 1950, to consider the proposed resolutions. No resolutions will be accepted after 5 o'clock of that day. On the following day, the proposed resolutions will be posted on the bulletin board at the meeting place, so that all members may know in advance what resolutions are to be discussed at the business meeting to be held on June 23rd. In this way, all members will have ample opportunity to discuss the proposed resolutions in advance, and be prepared to discuss them before final action is taken.

TENTH ANNIVERSARY MEETING, JUNE 21–23, 1950, WASH., D. C.

Activities of Los Angeles Section

The Los Angeles Section of the American Congress on Surveying and Mapping held a meeting on September 15, 1949, at the "Bit of Sweden" in West Hollywood, with 56 members and guests in attendance.

A short business meeting was held during which the Section Officers were elected for the year 1950, as follows:

Dyson S. Hamner, Burbank, *Chairman*
Lt. Comdr. Daniel E. Whelan, Jr., U. S. Coast and Geodetic Survey, *Vice Chairman*
Cecil E. Hanson, Los Angeles, *Secretary-Treasurer*
R. B. Huey, Los Angeles, *Assistant Editor*

The guest speaker was G. M. Leatherwood, Assistant District Location Engineer, who spoke on "Modern Engineering Control on State Highway Construction." The talk dealt primarily with the application of coordinates on construction lay-outs.

The Section last met on January 20, in the auditorium of the General Petroleum Building, with Dyson S. Hamner presiding.

A sound film, "The Manufacture and Use of Modern Surveying Instruments," by the Henry Wild Surveying Instrument Supply Co., of Brooklyn, N. Y., preceded an exhibit of their various instruments. A discussion of Congress activities by Comdr. Daniel Whelan, Jr., concluded the session.

—R. B. Huey

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Obituary

MARION WESLEY TODD was born at New Haven, Ind., on July 30, 1896, and passed away at Lafayette, Ind., on October 26, 1949.

Prof. Todd completed his course in Civil Engineering in 1921 and in 1926 received an M.S.C.E. degree from Purdue University.

After graduation from Purdue, he was employed as an instructor in Civil Engineering at Kansas State Agricultural College. In 1923 he accepted a similar position at his Alma Mater and served as an important member of the staff of the School of Civil Engineering until his death.

As a teacher he was always willing and able to discuss personal problems with the students in his classes, guiding them wisely through the difficult parts of his courses. His ability as a teacher was well known and appreciated by those who worked with him. Co-authorship of two important surveying text books resulted from his teaching and practical experience.

Prof. Todd was a member of the National Association of Professional Engineers, American Congress on Surveying and Mapping, and Chi Epsilon fraternity. At the time of his death he was serving as Chairman of the West Lafayette Park Board, and as a member of the West Lafayette City Plan Commission. He was also active in P.T.A. and served on important committees of Cubs and Boy Scout Advisers.

Besides his widow, he is survived by three sons and one daughter.

—Kenneth S. Curtis

NEW MEMBERS

INDIVIDUAL MEMBERSHIPS

ABDALA G, JOSE, Ing., Cartografia Nacional, M.O.P., Cano Amarillo & Estacion Qta. Sta. Ines, Caracas, Venezuela.

AINSWORTH, GORDON ELLERY, 2 Graves St., South Deerfield, Mass.

ALEXANDER, GERARD L., Map Division, New York Public Library, Fifth Ave., & 42nd Street, New York 18, N. Y.

BAILEY, FRANK "BILL," 913 S. Grand Ave., Los Angeles, Calif.

BEACH, JAMES C., C.E., P. O. Box 236, New Haven, Conn.

BEISMAN, HENRY E., C.E., San Miguel County Surveyor, 241 S. Plaza, Las Vegas, New Mex.

BRACEWELL, JOSEPH R., Sr., Civil Engineer-Surveyor, Buckhead Theatre Bldg., Atlanta, Ga.

BRAUND, JOHN J., Cartographic Engineer, 900 Alabama Ave., S.E., Washington 20, D. C.

BREWSTER, EDWARD C., 404 Bashford Lane, Alexandria, Va.

BROCK, HOBART M., County Surveyor and Engineer, 209½ Sanders Bldg., Clinton, Tenn.

BROWN, EDWARD B., Lt. Comdr., U. S. Coast and Geodetic Survey, Washington 25, D. C.

BROWNE, JOSEPH J., Jr., 1727 E. Ocean View Ave., Norfolk 3, Va.

BUENO, DIONISIO ANIBAL, Estrada Palma #221, Camaguey, Cuba

BURKART, WILLIAM J., Chief Surveyor, The Atlantic Refining Co., P. O. Box 2819, Dallas, Texas

CALDERON, ROMEO GOCHEZ, U. S. Coast and Geodetic Survey, Washington 25, D. C.

CANCIO, ROBERTO, Ing., U. S. Coast and Geodetic Survey, Washington 25, D. C.

CARDET, FRANCISCO, Ing., San Nicolas #308, Habana, Cuba

CAREY, KYRAN P., 5607 Green Tree Rd., Bethesda 14, Md.

CARR, THOMAS FRANCIS, Surveyor, Box 485, Hamilton, Bermuda

CARROLL, JOEL, Geodetic Engineer, U. S. Geological Survey, Room 6215, G.S.A. Bldg., Washington 25, D. C.

CASEY, JOHN T., C.E., Engineer and Surveyor, 68 Main, P. O. Box 60, Ware, Mass.

CESPEDES, MAYOR CARLOS SEPULVEDA, Castro #354, Santiago, Chile

CHURCHILL, MORTON V., 5601 River Rd., Washington 16, D. C.

CHYPAK, JAROSLAV, Land Surveyor, 219 Ridge St., Rome, N. Y.

CLARIDGE, REV. GEORGE C., St. Norbert College, West De Pere, Wis.

CLARK, M. E., Surveyor, P. O. Box 334, Yorkville, Ill.

COBB, DOW C., Apartado No. 246, Caracas, Venezuela

COCKEY, VINTON D., Prince George's County Surveyor, Laurel, Md.

COLLIER, SUSAN E., 17 Hiway 66 W, Rolla, Mo.

COOK, KENNETH W., Vice President, C. W. Cook Corp., Surveyors, 8459 Melrose Ave., Los Angeles 46, Calif.

COPLEY, J. W., Land Surveyor, 406 Jefferson Ave., East Point, Ga.

CREATH, NORRIS B., Surveyor, P. O. Box 1600, Midland, Texas.

DANIELS, ALBERT W., Licensed Land Surveyor, 2375 La Jolla Ave., San Diego 10, Calif.

DEGNAN, LAURENCE V., Senior Civil Engineer, Public Utilities Commission, 425 Mason St., San Francisco 1, Calif.

De MATTOS, DR. ALLYRIO HUGUENEY, Est. Jequitiba, 23—Gavea, Rio de Janeiro, Brazil

DOLLENBERG, FRED H., 709 Washington Ave., Towson 4, Md.

DONKER, RUSSELL F., Engineer and Land Surveyor, 18 Fountain St., N.W., Grand Rapids, Mich.

DUNBAR, MARION F., County Surveyor of Lands, 286 Falling Run Rd., Morgantown, W. Va.

EASTMAN, ROBERT F., County Engineer, County Bldg., Springfield, Ohio

EHMAN, JACK D., Surveyor, 898 Humble Bldg., Houston 1, Texas

EMMICK, E. F., Civil Engineer, 926 North Bethel, Olympia, Wash.

ENGLISH, VAN H., Professor of Geography, Dartmouth College, Hanover, N. H.

FARRELL, GORDON, Lands and Surveys Dept., Red House, Port-of-Spain, Trinidad, B. W. I.

FORD, GLENDON H., 11208 Huston St., N. Hollywood, Calif.

FOWLER, JAMES G., 1327 Bath St., Santa Barbara, Calif.

FOYLE, JAMES G., P. O. Box 945, Orange, Texas

FRESEN, E. C., Land Surveyor, 193 Hart St., New Britain, Conn.

GERBER, R. G., Surveyor, Box 1271, Corpus Christi, Texas

GIBSON, LACY P., R. F. D. #1—Box 237-A, Forest Park, Ga.

GLASS, ANDREW C., P. O. Box A—347, V. P. I. Station, Blacksburg, Va.

GRAY, EDWARD J., 16 Arnold Place, Norwich, Conn.

HAASE, P., & SON, Levstraede 8, Copenhagen, Denmark

HAMBRICK, JAMES H., Civil Engineer, Rainelle, W. Va.

HAMMON, ALONZO C., 4192 Wilshire Blvd., Oakland 2, Calif.

HAMNER, DYSON S., Licensed Surveyor, 402 S. San Fernando Blvd., Burbank, Calif.

HARDY, GEORGE D., Box 4970, Jacksonville, Fla.

HARRIS, W. C. "BUS," County Surveyor, Wayne County, Greenville, Mo.

HAVRE, GERTRUDE, 1343 Parkwood Place, N.W., Washington 10, D. C.

HENRY, LAURENCE O., Civil Engineer, 1226 12 St., N., Fargo, N. D.

HERBELL, C. P., Vice President, Sanborn Map Company, 629 Fifth Ave., Pelham, New York 65, N. Y.

HERNANDEZ, DR. JOAQUIN CALDERON, Calderon & Cia, Surveyors, carrera 19 No. 65-91, Bogota, Colombia, S. A.

HEYWARD, HAMILTON T., 1514 Girard St., N.E., Washington, D. C.

HILL, CLAIR A., Civil Engineer, P. O. Box 558, Redding, Calif.

HILTON, THOMAS EARL, Civil Engineer, 214 South Fairmont, Tyler, Texas

HOPKINS, H. C., Civil Engineer, 750 E. Colorado St., Pasadena 1, Calif.

HUTCHISON, JOHN ROBERT, Surveyor, 24 Royalist Rd., Cremorne, Sydney, N.S.W., Australia

INSKEEP, CLAIR A., Civil Engineer, 328 E. Sandusky Ave., Bellefontaine, Ohio

IRISH, SUMNER B., Professor, 203 Engineering Bldg., Washington Road, Princeton, N. J.

JEPPESEN, E. B., President, Jeppesen Co., Stapleton Airfield, Denver 7, Colo.

JEWELL, LLOYD V., 18457 Magnolia Dr., Detroit 19, Mich.

JOHNSON, MURVIN G., County Engineer and Deputy Surveyor, 201 E. Slocum St., Rice Lake, Wis.

JONES, H. CONGER, Civil Engineer and Surveyor, Box 562, Del Rio, Texas

KARGL, GILARD, 9333 Broadway, San Antonio 9, Texas

KASTENDIECK, GEORGE H., County Surveyor and Engineer, Springfield, Mo.

KATTERHENRY, ARNOLD A., Prof., Dept. Civil Engineering, University of Florida, Gainesville, Fla.

KELLY, A. B., 106½ W. Kansas, Midland, Texas

KIRSCH, E. H., Comdr., U. S. Coast and Geodetic Survey, Washington 25, D. C.

KLEIN, WILLIAM, 1836 Ingleside Terrace, N.W., Washington 10, D. C.

KUELL, CHARLES N., 68 Burgess St., Silver Creek, N. Y.

LACY, GEORGE H., Civil Engineer, Gulf Oil Corporation, P. O. Drawer 2100, Houston, Texas

LAMPRECHT, JOSEPH, Manlius Road, Fayetteville, N. Y.

LARRABEE, BRUCE M., Civil Engineer and Land Surveyor, R. D. 2, Lakewood, N. J.

LARSEN, JAMES H., County Surveyor, Court House, Racine, Wis.

LEATHERWOOD, GEORGE M., District Chief of Surveys, Division of Highways—State of Calif., 701 E. Chestnut St., Glendale 41, Calif.

LINTZ, CLARENCE F., Land Surveyor, 1717 Ketner Ave., R. F. D. 9, Box 474, Toledo 12, Ohio

LOWREY, PERRY O., Engineer, Aptdo 246, Socony Vacuum Oil Co., Caracas, Venezuela

MacPHERSON, MORAY J., 402 S. San Fernando Rd., Burbank, Calif.

MALTBY, CALVIN S., U. S. Geological Survey, Washington 25, D. C.

MANSFIELD, E. G., Deschutes County Surveyor, P. O. Box 593, Redmond, Ore.

MATTHEWS, COL, ALBERT G., 1342 N. Terrace, Tallahassee, Fla.

MAWHINNEY, RICHARD A., 41 Water St., Machias, Maine

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